RAILWAY MASTER MECHANIC

Index to Volume XXXVIII

JANUARY TO DECEMBER, 1914

ILLUSTRATED ARTICLES MARKED THUS* EDITORIAL ARTICLES MARKED THUS†

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RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S. MYERS, Vice-Pres. L. F. WILSON, V. P. & Editorial Director
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Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXIX Chicago, January, 1914 No. 1

CONTENTS.

Car Repair Statistics.

In an article entitled "Freight Car Repairs," published elsewhere in this issue, there are given interesting figures with regard to repairs to freight cars on two large transcontinental systems. On both roads the figures prove the inability of the light capacity car to stand the service. On the first named road, 65 per cent of the cars destroyed in 1907 were 25-ton cars or under. In 1913 but 13 per cent of the cars destroyed were 25-ton cars, but this was due to the fact, however, that less than one per cent of the total number of cars in 1913 were 25-ton cars, and it will be noted in this same year that 78 per cent of all the cars destroyed were 30-ton cars, showing that the lighter capacity cars were still suffering heavy damage as compared with the 9 per cent credited to cars over 30 tons.

In these figures it is interesting to note that, although the average capacity of cars had increased 38.83 per cent since 1907, the average tare weight had increased only 29.81 per cent, showing that on this road at least the contention that shippers were not using large capacity cars efficiently, was well founded.

On the second road, the most noticeable feature is the number of couplers pulled out and broken during the past two years. On one division they reached a total of 600 in one month, and a large percentage occurred on light capacity cars. Although on this road the number of 20-ton cars equals but 3.3 per cent of its equipment, the number of 30-ton cars amounts to 42.5 per cent of the total equipment. In the meanwhile the percentage of 40 and 50-ton cars has grown from 14.7 in 1909 to 54.2 in 1913.

Light capacity cars, when run in the heavy trains prevalent today, are adding materially to the high cost of repairs. Some roads have found it economical to equip their old wooden cars with steel underframes, and while of course this is a remedy, it is often a question as to whether the outlay is warranted.

A Change in Attitude.

During the past few months the newspapers, which to a large measure reflect the feeling of the public, have shown a change in their attitude towards railways. Quite a number of editorials have appeared expressing the opinion that regulation had proceeded far enough for the present and that the roads' appeal for higher freight rates should be granted. The trend of public opinion, as indicated by these editorials, is certainly a welcome sign to railway officials. The public is beginning to see that national prosperity is closely allied with railway prosperity and that when railway stocks are down it touches nearly everybody's pocketbook.

In a Chicago paper recently, E. D. Hulbert, vice president of the Merchants' Loan and Trust Co., and mentioned in connection with the new Federal reserve board, expressed himself as follows with regard to the outlook:

> Conditions in some respects are not as good now as they were a year ago. More men are out of employment, and the number is likely to increase before the turn comes. Such conditions as we are passing through now are pretty likely to search out the weak spots, and we may expect an increase in commercial failures.
>
> On the other hand, with the tariff and currency questions settled for some time to come, and with both the stock market and the stocks of merchandise largely liqui-

> dated, we have a more solid foundation for business operations than we have had for years, or perhaps have ever had before.
>
> The one thing more than any other that stands in the way of a business revival is the condition of the railroads. They are the largest employers of labor in the country, and when they are forced to curtail everybody is affected. If the railroads are permitted to make such earnings as are absolutely essential to the growth and healthy condition of any industrial enterprise, nothing, in my judgment, can prevent the rápid return of business activity and prosperity.

While Mr. Hulbert does not paint the future in glowing terms, his words indicate confidence in the coming year. His statements with regard to the railroads are especially significant. They indicate that those who know, realize that a complete return of prosperity is dependent on railroad earnings.

At this time it appears that the eastern roads will be granted a part or all of the 5 per cent increase in freight rates for which they asked. However, the matter has been delayed because one Louis D. Brandeis, employed by the government, has submitted a multitudinous number of questions to the roads which it will take some time to answer, as they call for a large amount of statistics. Some of these questions have to do with the number of superheaters in service, the number of automatic stokers, and other mechanical questions which Mr. Brandeis feels affects freight rates.

Standardization of Freight Cars

In a copyrighted article in the September, 1913, issue of *The Monthly Official Railway List,* E. P. Ripley, president of the Santa Fe, has expressed himself very forcibly on the freight car situation. This article was commented upon editorially in the September issue of this publication and has drawn out discussion from others interested in the problem.

F. A. Delano, president of the Monon, in discussing the question, expresses fear that such standardization might be carried to extremes. He, however, recognizes the need for concerted action and illustrates by calling attention to the standard of the Pennsylvania, the designs of which call for construction which by far exceeds in weight that of any other system. If these designs are correct, those of all other lines are far too weak. Setting the highest price for an ordinary box car at $1,400 and the lowest at $900, he feels that the most efficient car could be constructed by standard design, at a cost which would represent a big saving over the highest, and not be much more expensive than the lowest. Mr. Delano also calls attention to a fact which often escapes those who touch upon this subject—that the present M. C. B. rules place upon the car owner nearly all burdens of expense incident to cheap construction. He suggests that standards should be fixed little by little for draft rigging, sills, bolsters, etc., just as they have been fixed for wheels, axles, journals, arch bars, etc.

F. D. Underwood, president of the Erie, gives little attention to the question of general standardization, but calls attention to the immediate necessity for a standard method of attaching brake beams, a standard quality for journals and air brake hose.

Raymond Dupuy, vice president of the Virginian, expresses himself as favoring complete standardization of cars by legal requirement, under direction of the Interstate Commerce Commission.

It would appear that Mr. Delano's point to the effect that, since the car owner is responsible for expense of repair incident to cheap construction, he is the only one to suffer, is not well taken. It will be readily admitted by all familiar with the operation of long freight trains made up largely of foreign cars, that the damage to an individual car which fails in any part is of small importance compared with the damage which may and frequently does occur to other cars in the train, and which is also not infrequently represented in delays and blocked traffic; the objectionable practice of suspending brake beams from car bodies, for instance, might result in an accident which would cost the railway owning a car thus poorly designed only a few dollars, while the railway operating the car at the time of the failure might easily be placed to the expense of thousands.

The complete standardization of freight cars would be possible under federal requirement. It should be possible by agreement among the railways, and the objectionable features of the enforcement of such a federal law could be thus avoided. Such action by the railways cannot be expected at once, however, and in the meantime the Master Car Builders' Association would do well to extend its own work in the standardization of parts as rapidly as possible.

Machine Formers

The development of presses and bulldozers during the past few years has greatly decreased the cost of turning out duplicate parts in large numbers, and formers are constantly being designed to handle fork of this character at a considerable saving. Therefore the article on "Machine Formers for Locomotive and Car Parts," published on another page, is one which is of particular interest at this time when the motive power department is pressed to save every cent possible. It contains descriptions and illustrations of seven formers for various parts, which the author, Mr. Hedeman, states have materially reduced the production cost of these parts. These parts include draft sills, cab roof gutters, hopper door supports, arch bars, hopper car struts, tool brackets and box car corner bands.

The shop superintendent who wants to lower the cost of production will find it profitable to consider how these formers can be adapted to use in his own shop. It is possible that some of our readers are familiar with some of them or have improved upon them. If so, we would be glad to receive descriptions of them, in order that we may give our readers the benefit. The formers shown by Mr. Hedeman are well designed and with the increasing number of steel and steel frame cars in use, formers and dies are going to play an important part in lowering costs.

Loading of Cars

One of the recent meetings of the Car Foremen's Association of Chicago was devoted to a discussion of the loading of cars, and most of the members present expressed the opinion that the rules for loading were not being properly observed in all territories, thus working a hardship on the men in certain territories. This contention is true, for there is considerable divergence in the way in which rules are lived up to in different sections.

The fact that the loading rules are not lived up to can scarcely be blamed to any extent upon the car men, however, for they are

earnestly endeavoring to live up to the rules as they understand them. The difficulty is that they are not given sufficient backing by the higher officers and organizations in their dealings with shippers. The shipper may or may not be familiar with the rules. Even if he is familiar with them, he is apt to tell the inspector that he knows how to load his own cars. In cities where there are interchange bureaus, effective work is being done to overcome this condition of affairs, by going direct to the management of the various concerns and urging the necessity of complying to the loading rules.

Many improperly loaded cars come from the small stations along the line, where few of the agents have a proper knowledge of the loading rules and there is opportunity for educational work among these agents.

Another thought brought out at the above mentioned meeting was that the safety bureaus, which are now organized on practically all roads should take a hand in enforcing the observance of the loading rules. Many accidents and deaths have occurred by the sudden shifting of a load and it would seem that this would open a new field in safety work.

What is needed most is that the American Railway Association take steps to insure the fulfilling of these rules by the shippers. The business of the shipper, of course, is vital to the railway and no road can afford to lose business by antagonizing its customers. It is necessary that the rules be enforced on all roads alike by the action of an association which embraces all.

A MANUFACTURER, who has been for some time past, engaged in exploiting a device which, when applied to locomotives, has been proved to result in a very considerable increase in efficiency, recently expressed himself as satisfied that the adoption of such devices must be secured without the expectation of any assistance from the officers of the railway mechanical departments. On the contrary, he insists that any device which calls for considerable change in locomotive design, cannot be presented without incurring the absolute disfavor of such officers, generally speaking.

This impression is one frequently gained by novices in the railway field, mainly on account of the fact that they are technically unprepared to present their devices in proper detail to technical men and can deal only in glittering generalities with those who will listen. Coming from a man of years of experience in the field and one who is fully prepared to demonstrate and to back up his statements, as the gentleman above mentioned is, his attitude is surprising and should be provocative of careful thought.

HERETOFORE THE reports of department heads on the results of efforts for economy were supposed to be concluded with the endorsement of the executive officers of their roads. The Interstate Commerce Commission has, however, compiled a series of most searching questions, the answers to which will necessarily constitute detailed and voluminous reports, which are to be used as evidence in the investigation preliminary to the rate decision.

One of these questions calls for information as to the number of locomotives equipped with brick arches, superheaters, mechanical stokers and feed-water heaters. Another question deals with the installation of fuel-saving devices and the results therefrom generally. Those who have studied the problems touched upon by these questions are surely excusable for wondering how the mass of information demanded by these questions can possibly be handled in such a way as to assist the commission in reaching its decision. Who are the experts who will pass upon the advisability or inadvisability of the past and future practice of the railways with respect to these details? What possible result may be attainable from this catechism other than delay of the decision and a saddling of great additional expense upon the railways? If the questions are answered in detail and the reports made public property some benefit to mechanical officers may result in information with respect to the operation of certain devices which has not been voluntarily offered in the committee work of the American Railway Master Mechanics' Association. The developments will certainly be interesting.

Twenty Years Ago This Month

(From the Files.)

The Griffen Wheel Co., Chicago, has been formed to manufacture car wheels. The incorporators are T. A. Griffin, G. C. Willard and W. W. Evans.

The Westinghouse Air Brake Co. secures an injunction against the New York Air Brake Co. to prevent infringement of the former's patents. This ends a famous infringement suit which has cost an unusually large sum of money and has kept employed the best legal talent of the world.

The Chicago, Milwaukee & St. Paul is standing suit brought by the Pullman Palace Car Co. to recover damages for the breaking of a contract regarding the use of sleeping cars.

W. R. McKeen has been elected president of the Terre Haute & Indianapolis (Vandalia).

Joseph Billingham succeeds George Ott as master mechanic of the Baltimore & Ohio shops at Garrett, Ind.

The first practical test of the water power plant at Niagara Falls was made in Jan. 25.

The Alexander Car Replacer Co. of Scranton, Pa., has been incorporated with Jos. Jermyn, president; John T. Richards, treasurer; and James Russ, secretary.

Samuel Higgins has been appointed superintendent of motive power of the Lehigh Valley.

The Illinois Central has completed new shops at Burnside near Chicago, Ill.

The Armstrong shops of the Union Pacific at Kansas City, Kas., have completed a new locomotive for high speed heavy work. The locomotive is of the American type and weighs 62 tons. It will be used on the main line between Sidney, Neb., and Cheyenne, Wyo., for hauling sixteen coaches on through passenger trains.

The Chicago, Milwaukee & St. Paul is testing a process for making wood incombustible.

The report that the Lake Shore will build new shops at Collinwood has been revived. A. M. Waitt, master car builder, states that he has been called upon periodically to furnish plans for such a plant and that there are a dozen different designs around his office.

The engineering laboratory at Purdue University was dedicated January 19. It was destroyed by fire four days later.

The Atchison, Topeka & Santa Fe is considering the application of automatic couplers to comply with the law.

DATE OF GENERAL FOREMEN'S CONVENTION.

The executive committee of the International Railway General Foremen's Association met at Hotel Sherman, December 9th, 1913, for the purpose of arranging for the 1914 convention, and for the consideration of other matters pertaining to the best interests of the association. The secretary had received and read very cordial letters from the business men's associations of numerous cities inviting the association to meet with them, notably New York, and St. Louis, but after due and careful

consideration it was decided that Chicago was the most suitable city to meet in, due to its accessibility and accommodations. Therefore the next convention will be held at Hotel Sherman, Chicago, July 14-15-16-17, 1914.

The same plans will be followed as at last convention, the General Foremen meeting first, followed immediately by the Tool Foremen's convention, thus eliminating the necessity of the exhibitors moving their exhibits until both conventions are concluded.

The question of holding the 1915 convention at San Francisco during the Panama Exposition was considered, but the committee came to the conclusion that it would not be advisable to go so far especially at that time, for several good and sufficient reasons, so action was deferred until the next executive committee was elected.

Several others matters were discussed and decided upon, looking towards improvement in conducting the affairs of the convention, both socially and otherwise, and it is expected that the year 1914 will mark a new era in the annals of the association.

The General Foremen's Association covers an important field as its members are the men who are in actual touch wtih the details of shop production. An intelligent discussion of shop problems by these men is bound to make for economy and it is to be hoped that master mechanics and superintendents of motive power will give their support in urging their men to attend these conventions. Those desiring to join the association should communicate with William Hall, secretary, 829 West Broadway, Winona, Minn.

EUROPEAN LOCOMOTIVE DEVELOPMENTS.

Twenty powerful locomotives, the first of which has been delivered are being built by Robert Stephenson for service on the Natal section of the South African Railway system, where there are gradients of 1 in 30 (compensated), combined with 300 ft. radius curves.

The engines have four leading wheels 2 ft. 4½ in., eight coupled wheels 4 ft. 6 in., and two trailing wheels 2 ft. 9 in., in diameter. The cylinders have a bore of 22 in., with a piston stroke of 26 in., and the valve gear is of the Walschaert pattern. The heating surface is 2,361 sq. ft., to which the tubes contribute 2,212 sq. ft. and the firebox 149 sq. ft. The superheater (Schmidt's) surface is 503.04 sq. ft. and the grate area 36 sq. ft. At 75 per cent of the boiler pressure the tractive effort amounts to 36,375 pounds. In running order the engines weigh 155,680 pounds. The maximum axle load is 36,176 pounds. The tender has 400 cu. ft. of fuel space and a capacity for 4,250 gallons of water, the weight in running order being 112,784 pounds. The total length over buffers of engine and tender combined is 66 ft. 5½ in. and the total weight 323,264 pounds.

These locomotives, which are the heaviest yet constructed by Stephenson, are for the standard South African gauge, 3 ft. 6 in. They are being constructed from the designs of D. A. Hendrie, chief mechanical engineer of the South African Railways, under the supervision of H. G. Humby, consulting engineer to the High Commissioner for the Union of South Africa.

The progress of superheating is continuous both in England and on the European Continent. The latest news in England is to the effect that Locomotive Superintendent Hughes, of the Lancashire and Yorkshire, is now fitting several eight-coupled engines with his own arrangement of superheating apparatus. Mr. McIntosh is employing the Schmidt arrangement in some 2-6-0 engines he is building for the Caledonian, the first Moguls introduced into Scotland. The South Indian Railway is responsible for the first metre-gauge superheating locomotives ordered for service in Hindustan.

Reference has also been made in these columns to some of the important locomotive exhibit at the Ghent exhibition, Belgium. Mention might be made here that the exhibit of the Chemin de fer de l'Est, France, is one of the most imposing. This company has lately placed in service two tank engines with a 2-10-2 wheel arrangement fitted with the "Mestre" superheater. These engines weigh 117 tons and are simple engines with cylinders 25¼ in. by 26⅜ in. This design is a development of the previous eight-coupled class and would be regarded by some as falling under the designation "decapod," a term applied in the first place to engines with 2-10-0 wheel arrangement.

The Belgian State Railways are showing a "Baltic" (4-6-4) tank engine with four high pressure cylinders 16⅞ in. by 25⅝ in., its weight being 113 tons. This also is equipped with a superheater, and carries 6 tons of coal and 3,500 gallons of water. These heavy tank engines with six-coupled wheels and bogie "fore and aft" are becoming somewhat the fashion, and it is rumored that Mr. Billington is moving in this direction on the Brighton, England line.

Two very interesting engines have lately made their appearance on the Northern of France. These are superheater four-cylinder locomotives of 2-10-0 type, the one a compound on the de Glehn-du Bousquet lines, the other a simple engine. These are for working heavy mineral traffic over severe gradients and are doing fine work in actual service.

There is interest in the announcement that a Swiss locomotive-building firm has delivered to the Prussian State Railways the first practical oil locomotive built on the Diesel system. Considerable difficulty has hitherto stood in the way of adapting this type of motor to the special requirements of railway work, and the experiments have occupied a lengthy period. Even if it does not affect anything like a revolution in railway practice, this engine is distinctly interesting. The internal combustion motor has lately come in for a good deal of attention, although hitherto this type of motor has at best only had a restricted field of utility for railway purposes and the best results have perhaps been attained by the combination of petrol and electricity, which has been used with success for certain classes of passenger traffic. In the circumstances a successful oil engine would represent an important advance. The locomotive built for the Prussian Government is designed for express passenger work, and is capable of developing a speed of 62 miles an hour when the motor is running at no more than 304 revolutions per minute.

A Danish engineer of English origin has invented a railway signaling apparatus which he claims would in operation make absolutely impossible such an accident as that which occurred recently in England on the Midland Railway. In the case of this accident one train following five minutes behind a former one dashed into it, owing to the driver not observing the signals which indicated that the former train had come to a stop on a steep gradient. The invention is an apparatus for automatically indicating on the locomotive itself the position of the signals along a railway track. It consists of a vertical shaft placed near the railway track, said shaft being turned by the same gear used for operating the semaphore or light signals. The shaft is fitted with horizontal arms, which, when the locomotive passes by the shaft, operate vertical swinging arms on the locomotive. Through the ensuing movement each of the said arms closes an electric current. By these means a lamp of the same color as the one on the signal mast or corresponding to the signal given by the wings is lighted on the locomotive. The advantages claimed for the invention are that trains can travel at full speed in all weathers; no mistake can be made where signals are placed near each other and showing different lights; both men on the engine can see the position of the signals by means of the indicator on the engine; there is no unnecessary stopping or slowing down of the train, thus bringing about a saving in the coal consumption; trains are able to keep time in all sorts of weather. The system has been tested by the Danish State Railways at different speeds up to 56 miles per hour, in snowstorms, and has been found to work with security.

Machine Formers for Locomotive and Car Parts

By Walter R. Hedeman.

With economy as the foreword in railroad operation, anything which will tend to reduce the cost of manufacture of new and repair parts, for locomotives and cars, is gladly welcomed by the motive power department.

Each of the following formers or dies have materially reduced the production cost of the part which it is designed to make. It will readily be seen by shop foremen that the adoption of these tools, or tools embodying their principles of design and construction, will be a worth-while addition to their shop tool equipment.

Fig. 1 shows draft sill for steel cars, and is made with the three-piece, hydraulic press die shown on Fig. 1-A. The design of this sill is shown clearly on the figure, and the dies are designed to press out a right and left sill at one operation.

The hot sheets are laid on the lower or female clamping die, which is fastened to the bottom central plunger of the press, and the top flange of the sill is turned by bringing down the male clamping die, which is secured to the top central plunger.

The continuous front and bottom flange of the sill is then turned by raising the female or flanging die, which is fastened to the main platen of the press.

One-sixteenth-inch clearance is allowed between sheet flanges and dies, and the coefficient of expansion used is .0078.

Fig. 2 shows detail and application of cab roof gutter, to cabs above top of side cab window. This gutter was applied at the request of the enginemen, to prevent the water from dripping from cab roof on the neck of the engineman in rainy weather.

At first these gutters were made by hand by beating the metal around a piece of 1" pipe, bent to the proper radius. As a great number of these gutters were required, the dies shown on Fig. 2-A were designed to lessen the cost of manufacture.

These formers are for use on the bulldozer, and very little power is required to make these gutters.

The blanks are cut rectangular in shape and placed against face of female die. As the ram comes up with the male die fastened to same, the sheet is bent in the shape of an arc, and then carried into the female die beyond the shoulder, and is perfectly formed.

The female die is larger in back than in front; this is to permit the removal of the finished gutter through either end of the die.

Fig. 3 shows pressed shape used for supporting hopper door

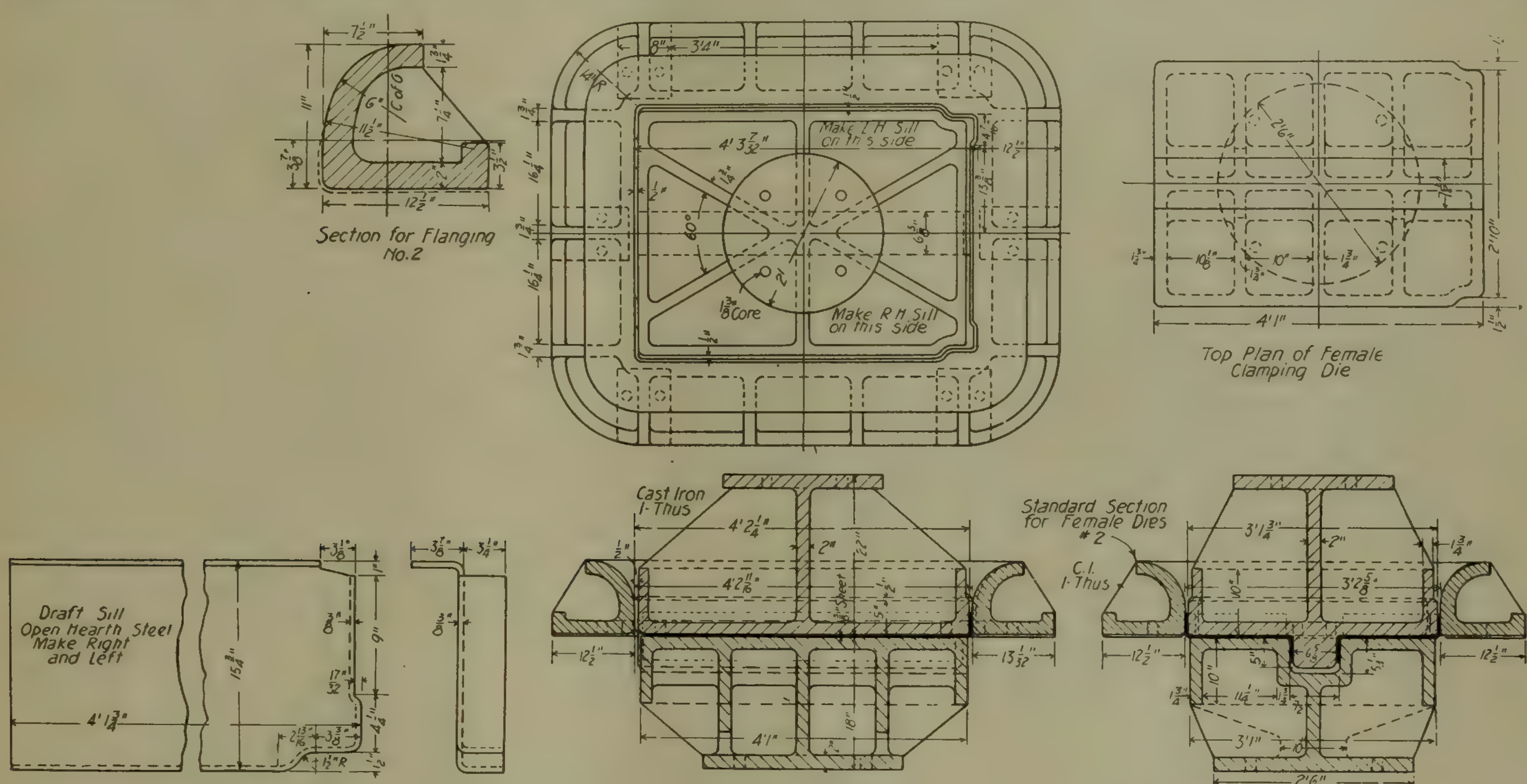


Fig. 1.

Fig. 1A.

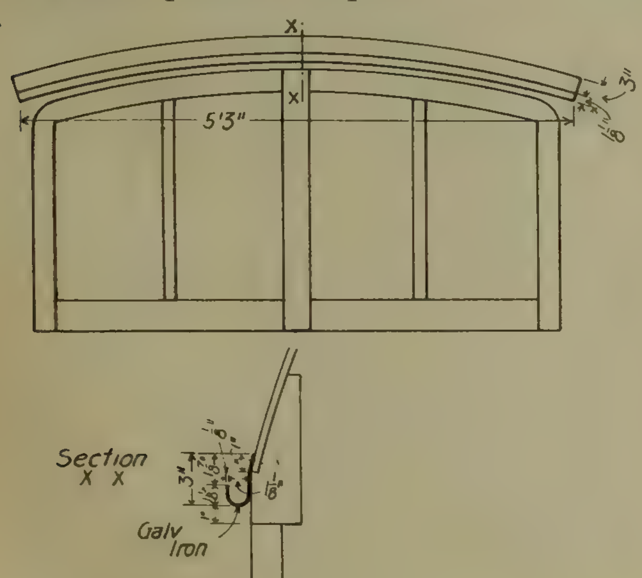


Fig. 2.

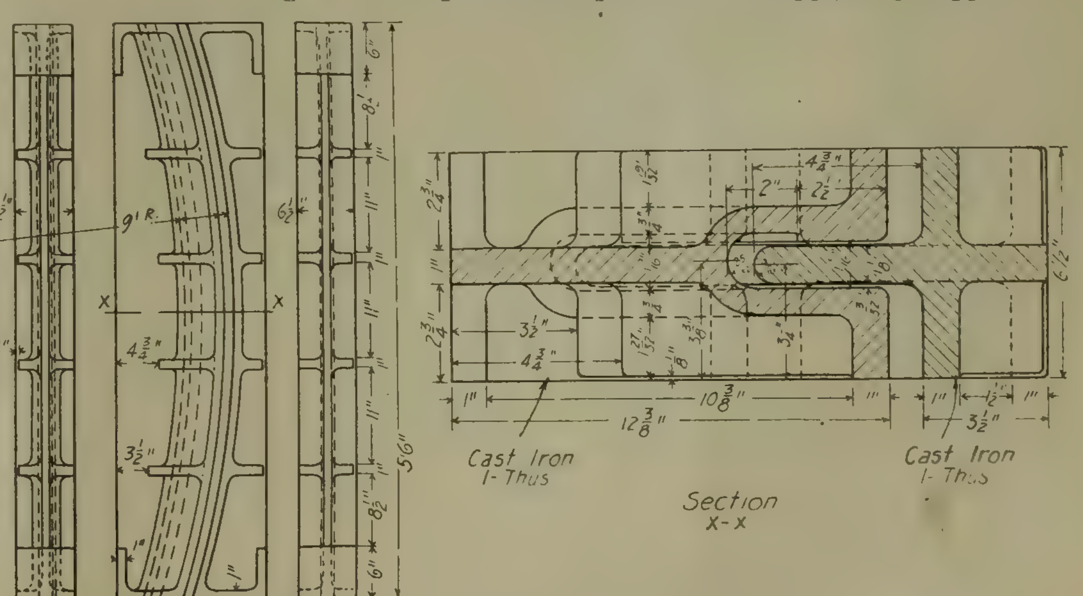


Fig. 2A.

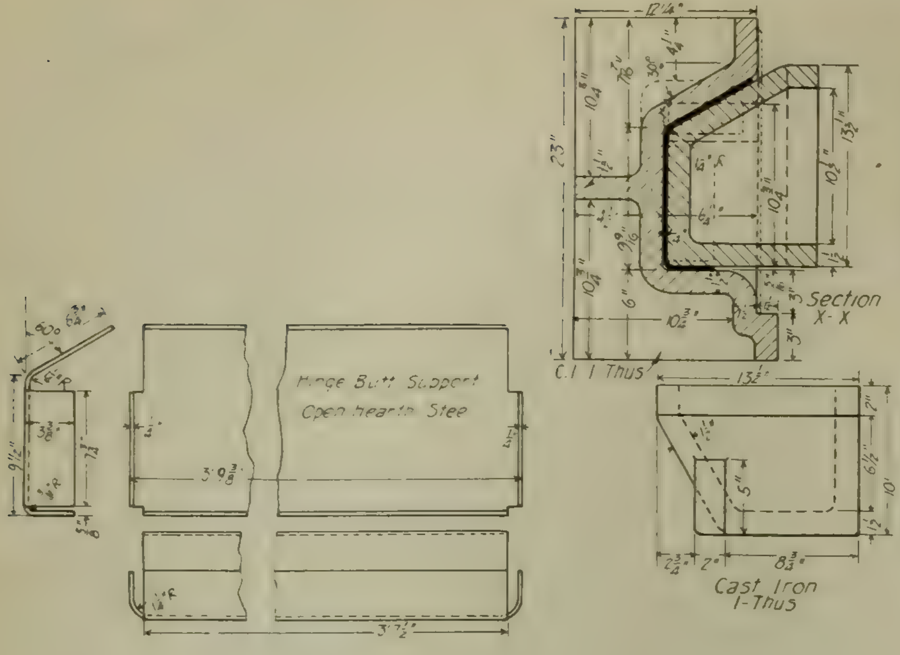


Fig. 3.

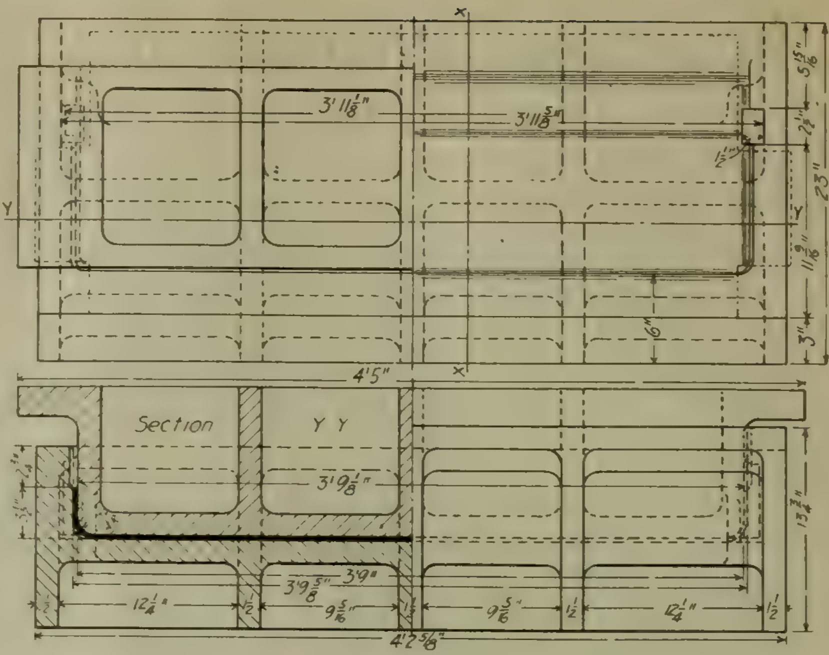


Fig. 3A.

hinge butts on steel cars of the hopper type. These hinge butts are made with the bulldozer formers shown on Fig. 3-A.

The female die is stationary, while the male die is movable, and is provided with flanges at either end to be drilled with suitably located holes to fasten die to ram.

The blank, cut to the proper shape, is heated and placed on ledge (as shown fine dotted on figure) in front of female die.

The 1"x2"x5" lugs on the front of the male die are provided to prevent male die raising when bending the sharp bottom flange on the support. One-sixteenth-inch taper is allowed at either end of the female die to permit easy removal of the shape when same is finished.

Fig. 4 shows bottom arch bar for freight car, and tender truck.

It is easy enough to make an arch bar without gibs, in one heat on the bulldozer; but to make the bar shown, with gibs, in one heat, requires a pair of formers similar to those shown on Fig. 4-A.

The design of these formers is clearly shown on the figure and the notes on same make the method of operating very plain. Arch bar without gib is formed on the first stroke of the ram, and gib or toe is formed on second stroke by dropping the auxiliary former "B" into position.

The two unused lugs on each end of the male die were provided for adding another toe squaring former if necessary, but same was not required.

Fig. 5 shows diagonal strut used on the end of steel hopper cars, for bracing the center and end sills.

It is necessary to make these right and left, and same can be easily made with the formers shown on Fig. 5-A. These dies are designed for use on the bulldozer and are simple in construction.

A total of ⅛" taper is allowed for the removal of the finished

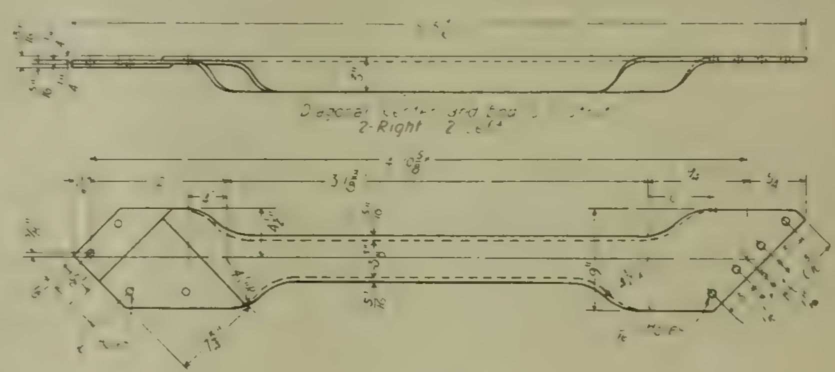


Fig. 5.

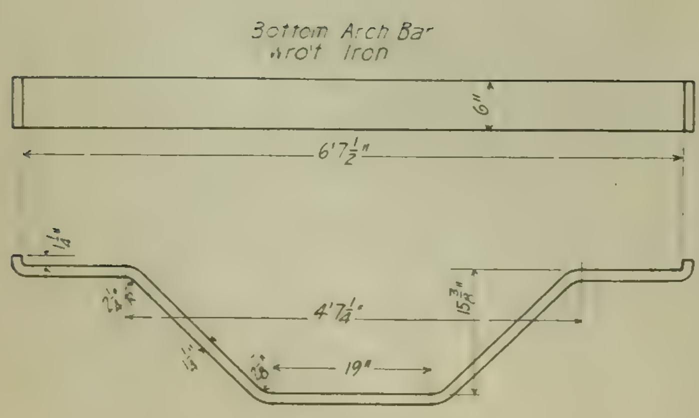


Fig. 4.

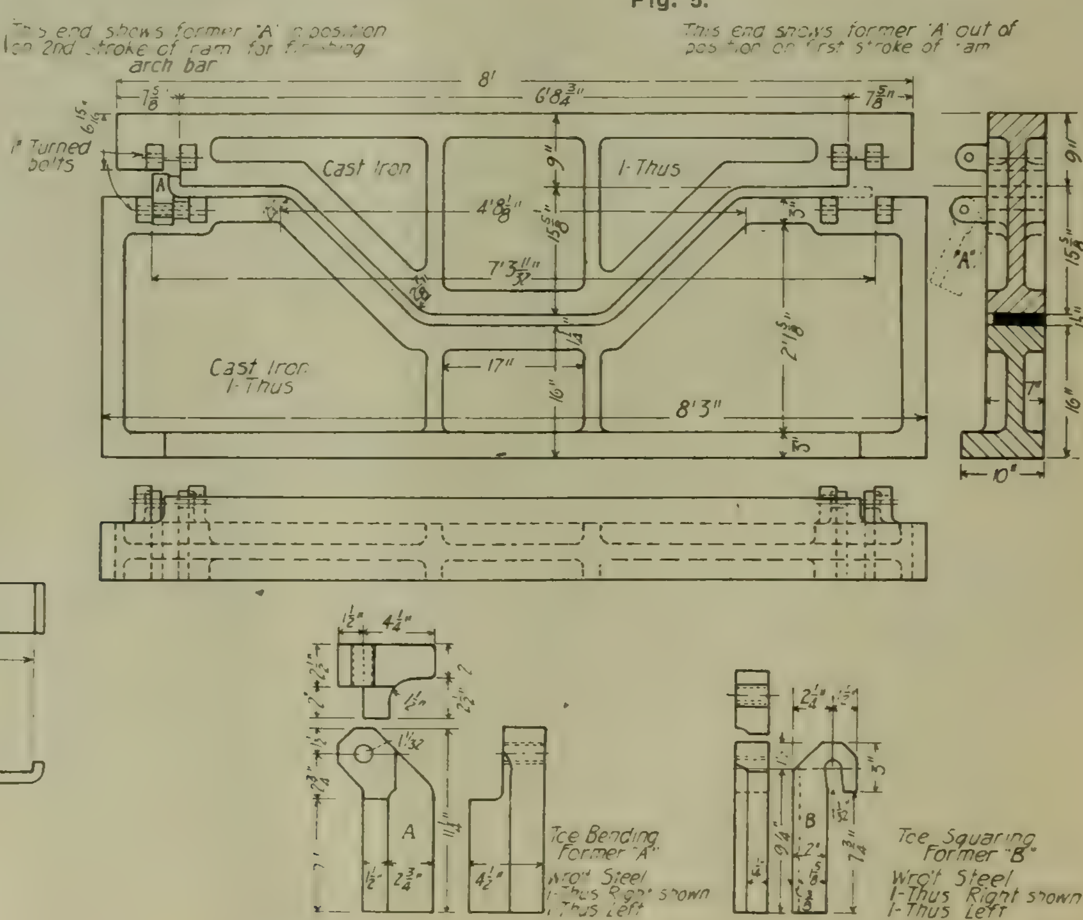


Fig. 4A.

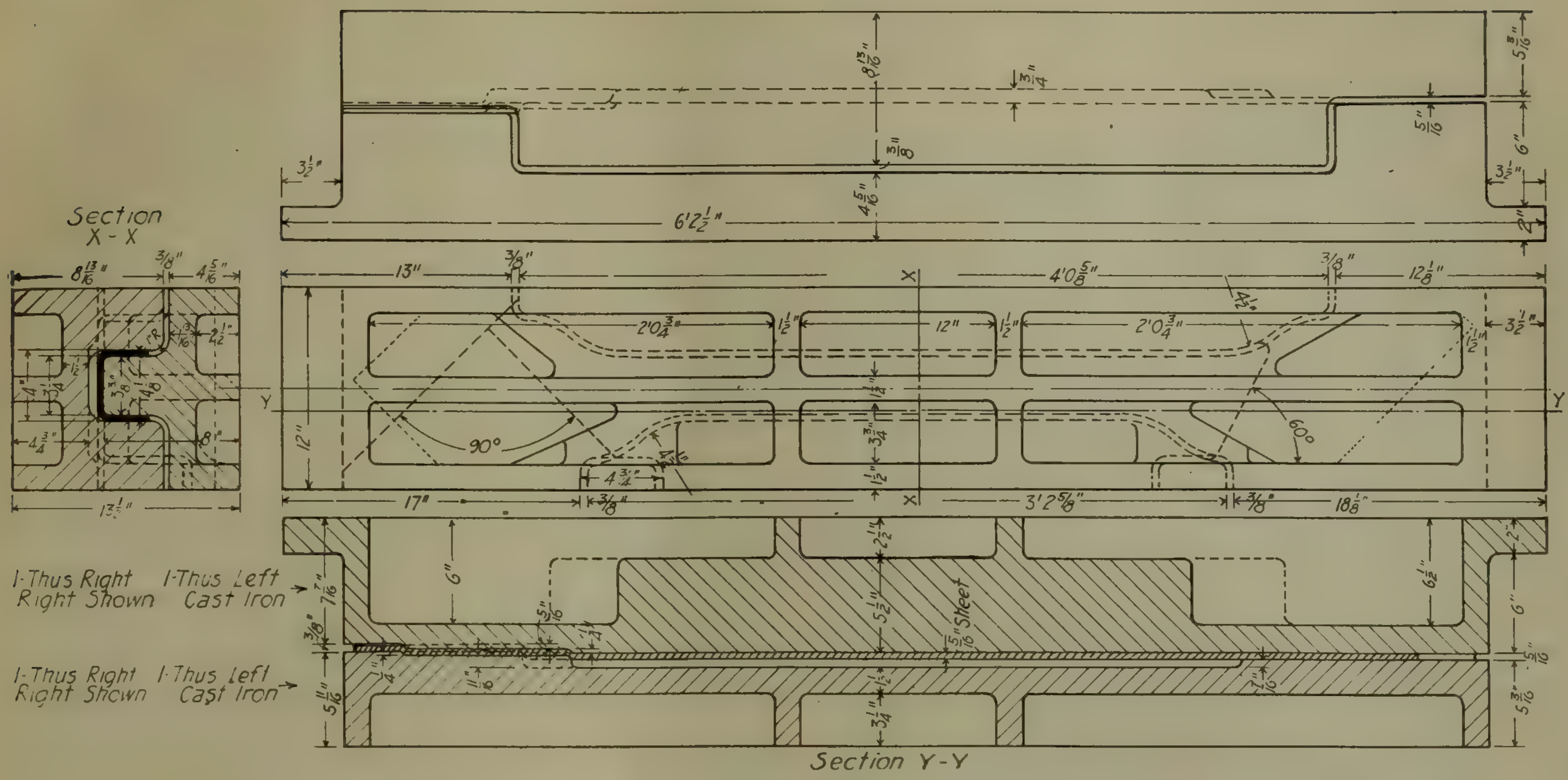


Fig. 5A.

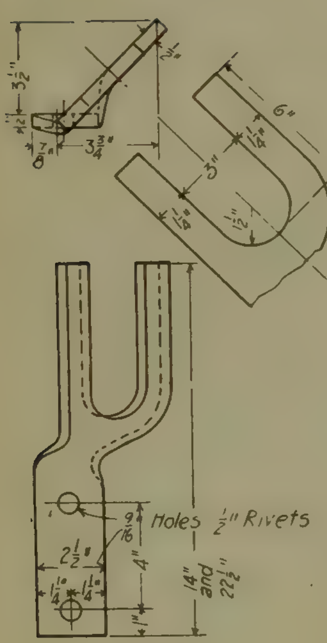


Fig. 6.

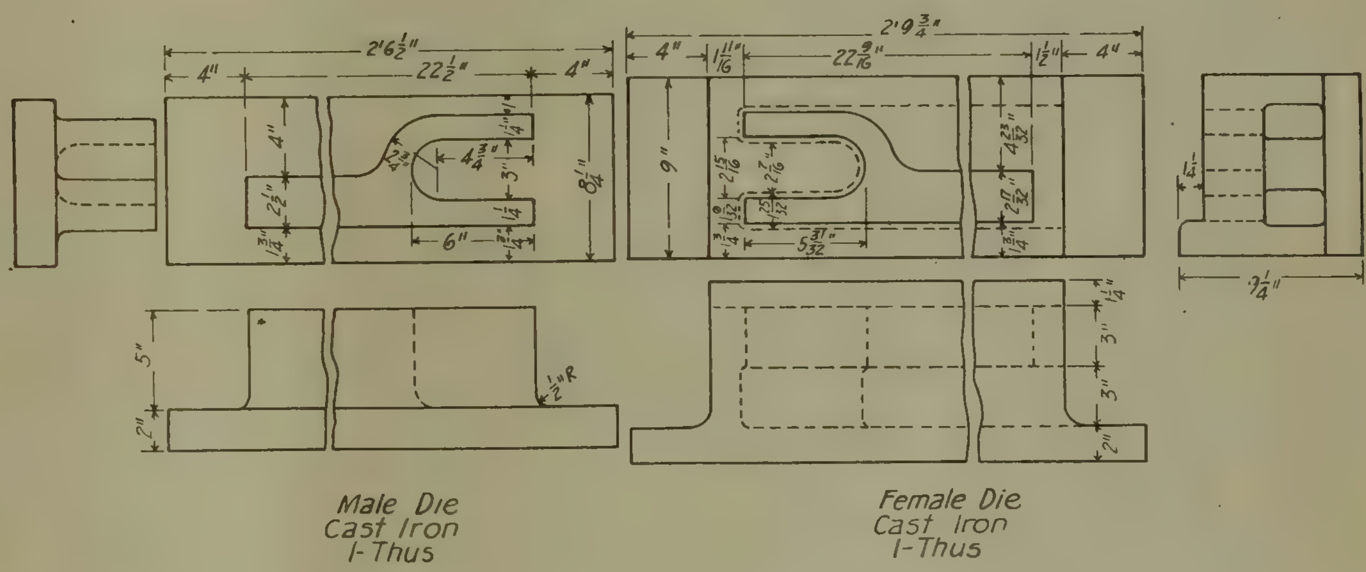


Fig. 6A.

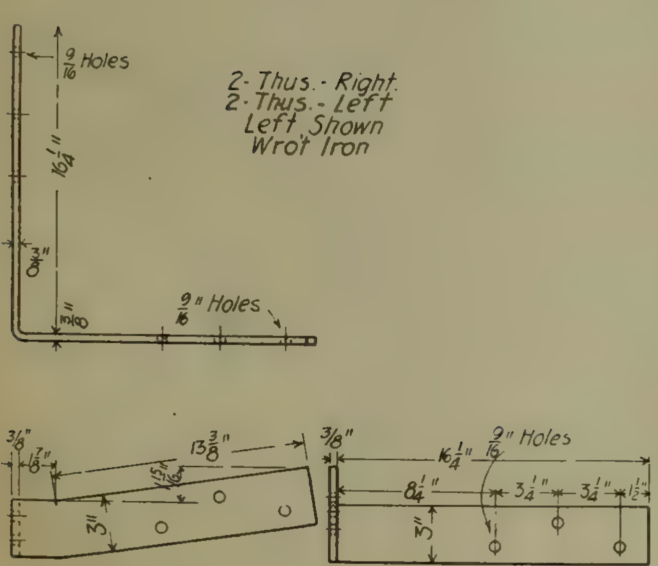


Fig. 7.

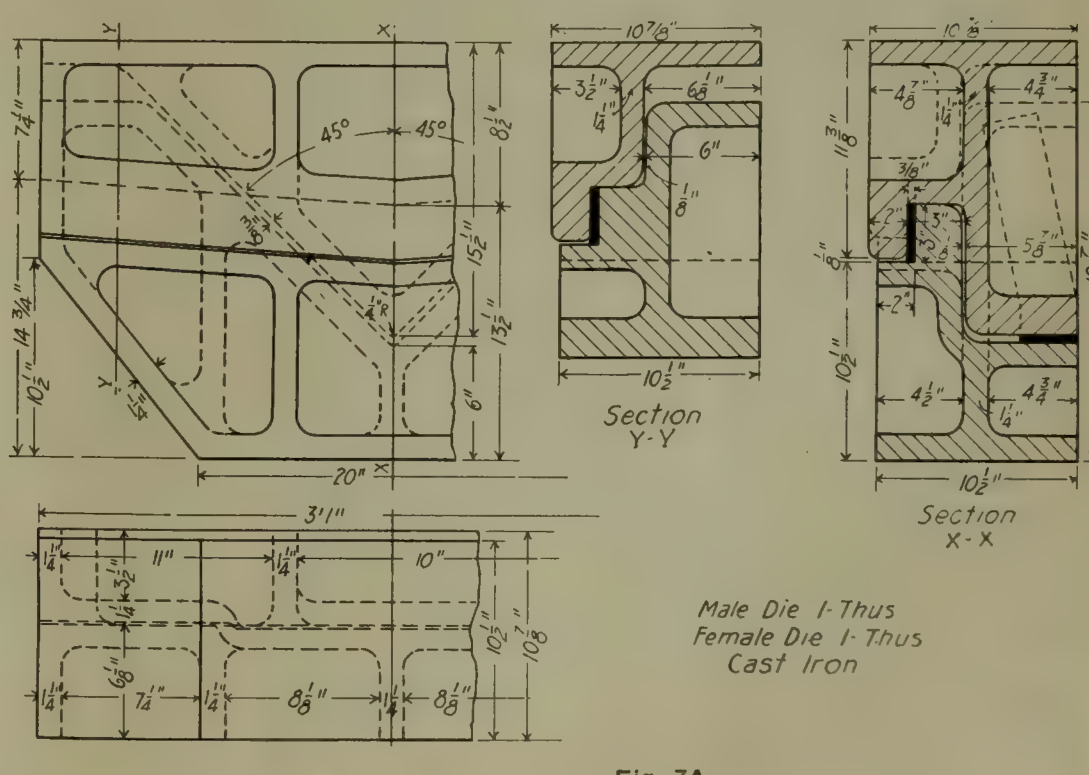


Fig. 7A.

shape from the female die. To insure getting the proper offsets in the ends of the strut the female die is made with $\frac{7}{16}''$ clearance at the middle portion, to give solid bearing to male die at the end where offsets are pressed.

Fig. 6 shows two sizes of fire tool bracket, one 14″ long and the other 22½″ long. These brackets are used on the front end of tender tanks for the fireman to hang the ends of firing tools on.

Brackets are made out of ½″ sheet steel, and twisted after being punched out with the dies shown on Fig. 6-A. The male die has the contour of the bracket and the hole in the female die is made $\frac{1}{32}''$ larger all around. Sheets are punched hot, and the two different lengths are made by using the proper length of blank. The finished bracket is removed from the female die, through the hole in the end of same.

Fig. 7 shows roof corner band for box car roof. This shape would be comparatively easy to make were it not for the $1\frac{15}{16}''$ set in one of the legs of the band.

These bands can be made with the bulldozer formers shown on Fig. 7-A, in two operations as follows: the heated strip is first placed flat side up on the ledge on upper front part of female die.

Ram is then advanced and the $1\frac{15}{16}''$ set is put in shape by male die pressing against same; male die is prevented from raising by lower part entering female die.

The partly finished shape is then placed edge up against lower part of female die, and another hot strip from furnace put in upper part of die. Ram is then advanced and lower shape is finished, while upper shape is given the first set. This operation is repeated until the required number has been made.

Rights and lefts are made by placing alternately the half finished shape with first made set to the right or left side of the female die.

DOOR TROUBLES.

By Frank Horn, Car Foreman, P. C. C. & St. L. Ry.

This subject is a serious one, not only to car designers and builders, but in a greater degree to freight and claim agents, the transportation department and last, but not least, to the repair and inspection forces.

Doors are of two general types, flush and outside, and in their present state of development neither is satisfactory. While both have their advantages from one point of view or another, they are overshadowed by the objections that are constantly arising due to loss of doors and consequent loss or damage to lading, not to speak of the cost of a door to replace the lost one and the many cases where property damage or personal injury or loss of life is incident to loss of doors from moving trains.

To commence at the seat of the trouble, false economy is to blame for most of our door troubles. In order to save a couple of dollars on the first cost of a car, the party responsible will choose a door faulty in design, difficult to operate, and in all probability one already in use on his own road, not because he wants that particular door, on account of any merit it possesses, but because it is cheaper than others.

So with no consideration for tomorrow, he inaugurates a series of loss and damage claims for his claim department, constant trouble for his inspection forces and expensive car repair bills for renewals and repairs of doors. Doors can be found all along his right-of-way, utilized as bridges over ditches, roofs or sides of out buildings, barn doors, etc. We see them daily, and they are so common that they no longer impress us as they should.

Flush doors, if properly applied, are in all probability less expensive to maintain than the outside type, and as a rule cars so equipped, require very little or no special preparation for shipments of inflammables and explosives. They exclude rain, snow and sparks, and are less susceptible to damage from sidewiping than outside doors. They cost more, however, and as a rule operate harder than the outside type, and unfortunately, most of those in common use are as easily, or possibly more easily, lost off than the other.

Generally speaking the outside door, overhung or sliding, has fixtures of less complicated design than the flush door, consequently they are cheaper and in more general use, while they afford less protection to lading and offer a better opportunity for pilfering.

Probably the most dangerous door in use is the overhung door with two or three guides or brackets spaced along the side sill to prevent the door swinging out at the bottom, but that same false economy dictates that as few brackets be used as possible, usually two, one at a point near either edge of the door when closed.

When, due to ignorance of how to operate a door, or because it actually is difficult to operate, men engaged in loading or unloading cars in freight stations or on team tracks, resort to force, and sledge and pry, they soon break away the corners and then the door can and does swing out to the destruction of itself or any less substantial object it may come in contact with.

Then again, doors are abused at loading points in another manner. No door is designed to retain lading in the car, and no lading should be placed in contact with the door, yet it is a common practice to pile lading of any description in contact with doors, and as soon as cars are moved the doors begin to bulge. Many cars are cut out of trains or doors lost off due to this practice.

Doors must be closely watched at all inspection points for indications of failure, either of the door itself or of its fastenings or fixtures and a car should never be allowed to leave a terminal, either empty or loaded if condition of doors indicates the least possibility of their coming loose or swinging out, or exposing contents of the car. "A stitch in time saves nine," and often a little preliminary repairs saves a door.

The remedy for this dangerous and expensive condition, in my opinion, lies in concerted action to standardize doors. If a committee of the M. C. B. Association, ignoring cost, and setting aside individual preferences, were to go at the door problem in a thorough manner, and without regard to existing cars, and devise a door and fixtures that would meet the demands of the Interstate Commerce Commission and the Bureau for Safe Transportation of Inflammables, Explosive and other Dangerous Articles, that would have the requisite strength and at the same time operate with reasonable ease (edges and corners protected by suitable metal designs), and the Association would adopt it as a standard, 75 per cent of the door troubles, and 90 per cent of the wrong repairs (incident to present wide range of door design), would disappear.

While the initial cost would be higher, there can be no doubt as to the ultimate saving, not only in the actual cost of repairs, but also in fewer detentions incident to shopping cars owing to door troubles. Until some such remedy is applied we will be compelled to go on as in the past making the best of the bad conditions as we find them.

The Baldwin Locomotive Works is building a Mallet compound locomotive which, it is said, will be the largest and have the greatest tractive power of any engine ever built. It is to be used in hauling long freight trains on heavy mountain grades of the Erie system. The weight of the locomotive will be 410 tons and the tractive power 160,000 pounds. It will have capacity for 10,000 gallons of water and 10 tons of coal.

Joseph W. Peters has been made secretary of the board of managers of the Association of Engineering Societies. His office is at 3817 Olive street, St. Louis, Mo., at which place the Journal of the Association of Engineering Societies will be published.

The National Association of Railway Commissioners has by unanimous vote committed itself to a proposition advocating general uniformity in interstate express rates.

CUTTING AND WELDING DEVICES IN RAILROAD WORK.*

By A. W. Whiteford.

All modern cutting and welding devices, irrespective of type, design, the source of their energy, or the principle involved, are built with but one object in view—a more flexible distribution of power.

They are not intended to perform any labor nor to accomplish any result that has not already been accomplished by some standard means, but they do it in a different manner. The result of their efforts is usually seen in one of three different ways; a decrease in time required—an increase in efficiency—or a reduction in cost.

They have, perhaps from lack of a better or more comprehensive term, gradually come to be known under the head of autogenous welding devices.

This really is a misnomer, as *autogenous* welding in its literal sense means *self*-welding or welding by means of heat alone. Some authorities have made an effort to divide the work into two classes, one to be called autogenous welding and the other to be called heterogeneous welding; autogenous welding to include all welding where no outside metal was introduced, and heterogeneous welding to include all welding where an alloy or foreign substance of any kind was used.

This hardly seems to be correct either, as in each class there would then be a division of principle. A more recent effort has been made to divide them according to their sources of power. This would class them under two heads—electricity and gas. As all the electric machines receive their power from an electric current, and as all the gas machines receive their power primarily from the gas of combustion which is oxygen, it would seem that the terms electric welders and oxywelders would not be far out of the way.

Whatever might be their names, however, and irrespective of how they might really be classed, the history of their various developments presents some interesting features.

The electric group has two mains divisions. Resistance or sectional welding and arc or surface welding. Aside from the fact that they both receive their power from an electric current they are in no manner similar.

Resistance welding was developed by Prof. Elihu Thompson at Franklin Institute in Philadelphia, in 1877. He was conducting some experiments with a Leyden jar and he noticed that under certain conditions the two coils of wire with which he was working would become fused together at certain spots. The result of his investigations is what we know to-day as the "Thompson process." Briefly, it consists in passing an electric current through two pieces of metal brought into close contact, the resistance at the point of contact generating enough heat to cause the ends to fuse when sufficient pressure has been applied mechanically.

The arc or surface system of welding has three divisions each division being named after the man who first developed it.

The earliest effort at producing anything of this kind of which we have any record was made in 1874, by a German named Werdner. He attempted to take an electric arc and deflect it by means of an air jet and thus secure what would have practically been an electric blow pipe, but his efforts do not seem to have been successful.

In 1881, a Frenchman, by the name of De Meriten, succeeded in welding lead plates together for use in battery jars by means of an electric arc, but nothing seems to have come from it.

Two Russians were next, Benardos and Olszweski, who developed an arrangement whereby they passed an electric current from a carbon electrode, which was one terminal, to the metal to be welded, which became the other terminal, the result being the formation of an arc between the two which generated sufficient heat to flow the metal within a given radius and thus produce a surface weld. This is what is known as the "Benardos Process," and is the first arc welding machine that was successfully developed. This was about 1884, and the United States patent was issued in 1887.

Benardos was followed closely by Slavianoff, a fellow countryman, who got out a very similar device except that where Benardos used a carbon electrode, he used a metal electrode of substantially the same composition as the metal to be welded. This idea has been known ever since as the "Slavianoff process." From these two original ideas all subsequent arc welding devices have been developed with the exception of an idea worked out by Zerener, a German, which came out somewhat later. He really tried an improvement on the original Werdner idea of deflecting the arc, only instead of using an air jet he used a magnet. This idea, like Werdner's, has never been very extensively developed.

The Benardos and the Slavianoff processes, however, have been developed to quite a considerable extent, not only in Europe but also on this side of the water.

The Siemund Wenzel Company, of New York, were the pioneers in this work in this country followed closely by the C. & C. or Garwood Company of Garwood, New Jersey, and to these two concerns belongs the credit for introducing the idea into American railroad service. The machines and outfits are made in various types and sizes—both portable and stationary—and you are all more or less familiar, no doubt, with the equipment and the work that is done by it.

Standing somewhat by itself, although really allied to the gas branch, is what is known as the alumino-thermite process, or "Thermit welding." This is a German development, brought out about 1900, and consists of an arrangement whereby the uniting of metallic oxides and aluminum is brought about in such a way as to produce a flowing mass of metal at about 5400 Fahrenheit. This is made possible by the increased affinity that the aluminum has for oxygen over the balance of the mixture. When ignition takes place, the oxygen in the other metals makes a rush for the aluminum, the aluminum oxide rising to the top in the form of a slag; the free body of clean metal, still at a flowing heat, then running down into the mould and joining the parts together.

The gas branch of these cutting and welding devices also has several sub-divisions. Unlike the electric group, however, these are not divisions of principle, but only divisions of degree.

These sub-divisions usually take their name from the secondary gas which is combined with oxygen to secure the necessary heat. They come under various heads such as coal gas, Pintsch gas, water gas, Blau gas, hydrogen and acetylene.

The principle involved is the same in all cases, being the proper combination of the secondary gas with the main gas or the gas of combustion, which is oxygen; and the various degrees of efficiency possible in each case are directly proportionate to the amount of oxygen required to produce the proper temperature.

With coal gas you are all, no doubt, familiar. The same is also true of Pintsch gas.

Water gas and its by-product, producer gas, is formed by passing jets of steam through furnaces filled with coke which has been brought to a glowing heat.

Blau gas is a form of liquefied illuminating gas produced by the distillation of mineral oils in red hot retorts. This is in a manner very similar to Pintsch gas. Chemically, it consists of the same elements as coal gas, but in essentially different proportions.

A combination of oxygen and practically any heat carrying gas can be utilized for cutting metals, but as far as we know, in the present state of the art, no torch has yet been developed whereby welding can be successfully or economically done with any of the above combinations. From the standpoint of general service, therefore, all these other gases may be disregarded as either the operation is slower, the oxygen consumption is much larger, the cost is greater, or the work is more inefficiently done than with either hydrogen or acetylene.

Historically, hydrogen should be mentioned first. It was discovered in 1766 by an English chemist—Cavendish. It is a primary gas, and is the very lightest substance known. It was named hydrogen, or water-former by Lavoisier, a French chemist,

* A paper delivered before the New England Railroad Club.

from the fact that it was found so plentifully in water, and in fact, water is still the greatest source of its supply—the term H_2O, no doubt, being familiar to you all.

Acetylene was also discovered by an Englishman, Sir Humphry Davy, who detected it by the odor, while making some experiments with potassium in 1836. Some years later, Berthelot, a Frenchman, succeeded in making some of it by passing a jet of hydrogen through an electric arc. In 1862, Woehler, a German chemist, succeeded in producing it from a combination of lime, zinc and carbon, which he brought to a white heat. This was the forerunner of calcium carbide. It was first liquefied by Cailletet, in 1877, and Claude and Hesse succeeded in working out the process by which it is possible to dissolve it along about 1895. Acetylene gas as we know it is formed by combining calcium carbide and water. Calcium carbide is the metal found in lime rock fused with a low-ash coke. The credit for the commercial development goes to an American, J. M. Moorehead, who in conjunction with Wilson successfully worked out the problem of producing it from lime rock, which they did down in North Carolina in 1892.

To Moorehead, also, goes the credit for the development of the process whereby acetylene can be compressed into cylinders, along the line of the idea first laid down by Claude and Hesse. These cylinders are packed with porous asbestos and filled with acetone into which the gas is dissolved. Acetone is a form of denatured alcohol which possesses the peculiar property of being able to take to itself twenty-five times its own volume of acetylene gas for every atmosphere of pressure under which it works.

Oxygen, however, is the real factor in the successful application of either hydrogen or acetylene. It is one of the primary elements and also one of the most abundant. It comprises about eight-ninths of all the water, and about fifty per cent of all the rock in earth. It is also very prevalent in flesh and human tissue, sixty-six per cent of the human body being oxygen. In volume it is twenty-one per cent, and in weight eighty-eight per cent of the air.

It was discovered in 1774 by Priestley, an English chemist, and very nearly so by Sheele, a Swede, in 1772; but he had not been quite able to prove his case, so the honors divide.

In 1789, Lavoisier proved conclusively that it was the gas of combustion and that without it no combustion was possible. Guy Lassac worked out the law of combining gases by volume in 1808. By 1851 they had gotten so far as to try and manufacture it. In 1877, Pictet, a Swiss, and Cailletet, a Frenchman, proved that it could be liquefied. By 1880, the electrical angle had been introduced, and finally came the atmospheric development.

As a final result of about one hundred years of experiment and research, oxygen can now be produced successfully in three ways—chemically, by electrolysis and from the atmosphere.

The chemical method consists of putting chemicals of various sorts, generally potassium chlorate and dioxide of manganese, into a retort, sealing them up and bringing them up to about 400 degrees of heat. Oxygen is set free at this point, properly washed and cleaned, and stored for service.

The electrolytic process consists in passing an electric current through a given volume of water and setting free the hydrogen and oxygen of which water is composed. This is done by putting sulphuric acid in the water, which forms what is known as an electrolyte, and the action of the current then sets the gases free, the hydrogen following the negative pole and the oxygen the positive pole.

The atmospheric process consists in taking it out of the air and separating it from the nitrogen by what a layman would call the "freezing" process. This is done by reducing the temperature of the atmosphere in given volumes under pressure to a point at which the oxygen liquifies. This is in the neighborhood of 320° below zero. The oxygen is then drawn off, expanded and compressed into cylinders ready for service.

There are various methods whereby these separate ideas for making oxygen are carried out. Bassingault developed the first of the chemical processes in 1851, but Brin's process, which was developed later, seems to give more satisfactory service. Any of the chemical processes are much more expensive and the product less satisfactory for service than either of the others.

The method worked out by Garuti, an Italian, seems to lead in the electrolytic line, the largest American plants such as the American Oxy-hydric Company of Milwaukee and about 80 per cent of all the European plants using this process.

There are various other developments of this electrolytic idea, chief among which are those of Shuckert, Schmidt, Flamand and Renard, but Garuti's system has the advantage for two reasons:

First—Lower amount of electric motive force required.

Second—More perfect separation of the gases.

There are also several types of the atmospheric process, including those of Knudsen and Claude.

It remained for a German, however, Dr. Carl Linde, to really perfect the atmospheric process, which he did in 1895. His idea or what is known as the Linde process is generally conceded to be the simplest, cheapest, most efficient, and to produce the purest oxygen of any of the atmospheric systems.

Practically all the commercial oxygen used in this country and also a very large part of that used in Europe, where hydrogen production is not a factor, is the product of equipment working on the Linde principle.

The development of the torch also played its part in the working out of these various devices. Like many of the gas developments, an oxy-hydric blow pipe was known to chemists for years before it branched out into other fields. The first man who seems to have made an effort to apply the idea practically was an Englishman, by the name of Fletcher. He experimented with coal gas and oxygen in 1886, but either owing to the fact that he had nothing but coal gas to work on, or because his oxygen was poor, he never made a success of it.

The first man who really developed the idea was a Belgian by the name of Jottrand, who used it successfully to cut metal in 1888. He used a combination of hydrogen and oxygen.

The next man to follow the idea and the first to use acetylene with oxygen was a Frenchman, Le Chatelier. This was about 1895. Next came Fouché and Picard in 1901 and 1903; then Rodrigue-Ely and Gauthier, and then again Fouché's later developments in 1908. Up to the present time these include all the main ideas of the different types of torches in use.

As to a comparison of the work done by the two separate combinations of hydrogen and acetylene with oxygen, it is safe to say that each has a field in which it is supreme; cutting and welding can be done with both; hydrogen is most effective for very light welding, say under a sixteenth of an inch in thickness, and for very heavy cutting of say over ten inches in thickness. In the entire intermediate field, that is, all welding one-sixteenth and over, and all cutting up to ten inches, which range covers practically all of the work done on railroad shops, acetylene is most efficient. In either case, however, successful welding depends on the following:

1—Purity of the gases.

2—Use of metal filler as near as possible to the same composition as the metal to be joined.

3—Thorough fusion of the inside surfaces before adding additional metal.

4—Cleanliness of the parts.

5—Control of the mixture and size of the flame.

There are also various features of torch design and construction that might be entered into in comparison with the various classes of work to be done, but from a general standpoint of service demanded, any torch to be satisfactory should include:

1—Perfect interchangeability of parts.

2—Ease of adjustment.

3—Convenience of handling.

4—Constant gas consumption.

5—Constant pressure.

6—Largest possible opening at nozzle tip for each thickness of weld.

The application of these devices to railroad service also pre-

sents various problems. These problems are usually solved in accordance with the conditions under which the equipment has to work.

Either of the three gases can be obtained for use in one of two ways. They can be generated on the ground for immediate use, or they can be generated at central plants and distributed in portable containers. In the general run of railroad work, the most widely adopted plan for the handling of either oxygen or hydrogen is to secure it in commercial cylinders from the nearest source of generation. The same thing can also be done with acetylene; for all work where the demand will not warrant the installation of a generator the dissolved or commercial cylinder process is used, but in the larger plants it is usually piped from a generator installed on the ground.

These generators as built to-day are of two types:

1. Water-to-carbide, in which water is brought in contact with the carbide, the volume of carbide being in excess of the volume of water during the first part of the operation.

2. Carbide-to-water, in which the carbide is thrown into the water, the volume of water always being in excess of the carbide.

Irrespective of types, however, it is generally conceded that successful generators embody the following points:

1—Low temperature of generation.

2—Complete decomposition of the carbide.

3—Maximum evolution of the gas.

4—Removal of all air from the generator before gas generation starts.

5—Low pressure in all parts of the generator.

6—Continuous supply of gas, simplicity of mechanism and ease of recharging.

As to the general use to which these various systems are now being put, it is safe to say that either one system or the other is rapidly making its way into every known branch of the metal working art. This is particularly true of oxy-acetylene. From a standpoint of volume, America leads the world, with Germany second, France third and England a rather poor fourth.

In scientific research and special development, Germany leads all other countries. This is partly due to the fact that the German government has taken a hand in the work and established schools at various points, where the art is taught as one of the applied sciences.

In all of their leading industrial centers, such as shipyards, steel mills, gun works, etc., oxy-acetylene has become part of their regular equipment. In the manufacturing lines especially this system is greatly used.

As one feature of the work over there, I might mention that piping of all classes and sizes is now being made by rolling from flat plate, and welding by means of the oxy-acetylene torch. Piping is also being laid without the use of threads or flange joints. In this way they are enabled to use pipe of about half the thickness of our standard pipe, thereby saving greatly in material costs. To show what the German government thinks of this, it is only necessary to mention that at Cologne, in the new Palace of Justice building only recently completed, there is nearly seven miles of piping in which there is not a single threaded joint, all being welded by the oxy-acetylene method.

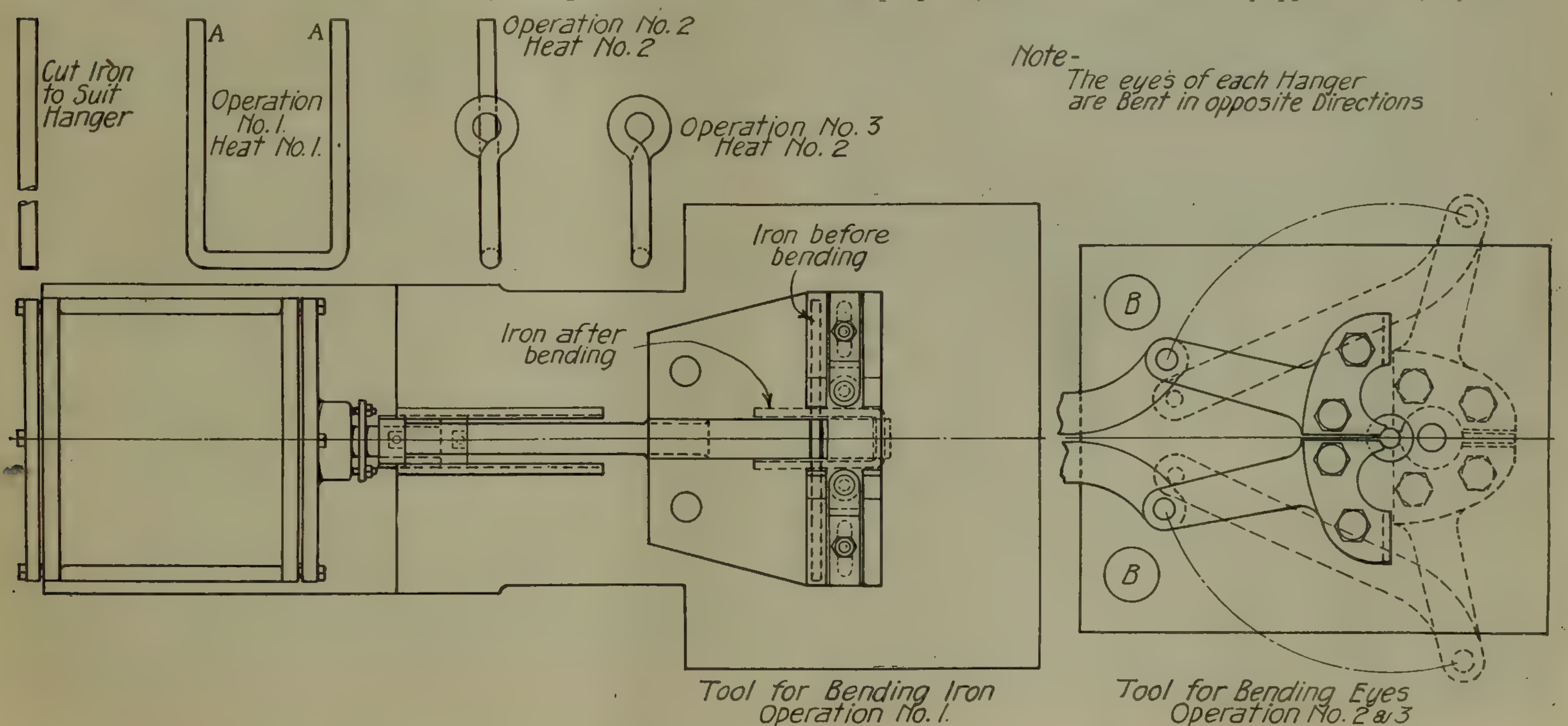
Wonderful progress has also been made here in America. To Massachusetts belongs the credit of having installed the first plant in this country. This was at Quincy in 1905, by the Fore River Ship Building Company. This was only eight years ago, and to show how rapid has been the growth in the United States, I will cite the fact that in one of the latest battleships turned out at one of the navy yards, about $70,000 worth of the work was done with oxy-acetylene equipment. The work of raising the battleship Maine at Havana was also very greatly facilitated by the same means.

MANUFACTURE OF AIR BRAKE HANGERS.

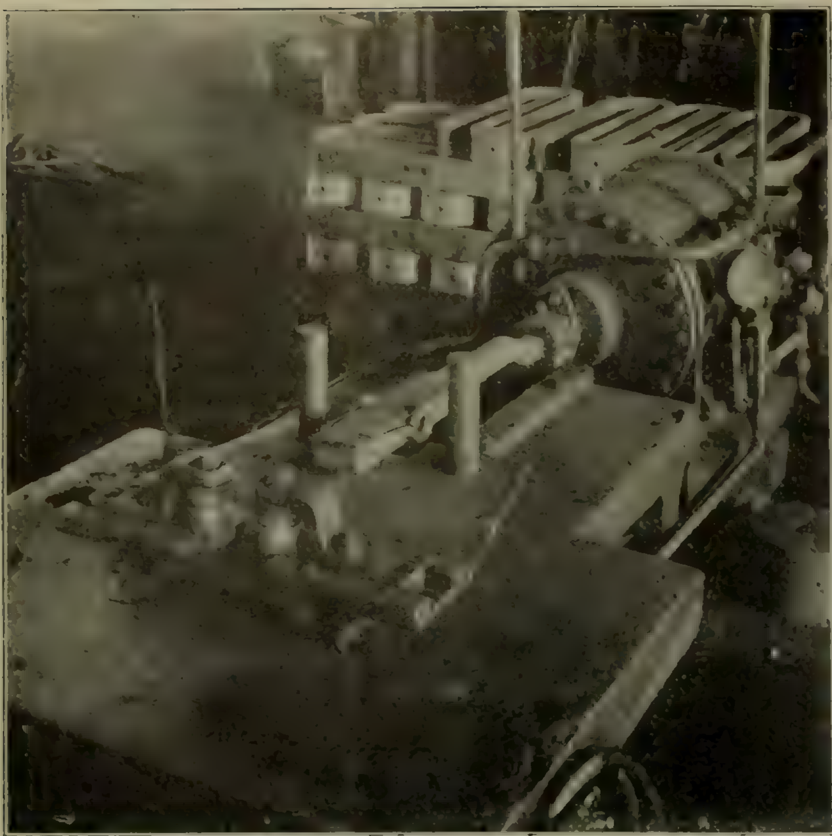
By E. A. Murray, M.M., Chesapeake & Ohio Ry., Clifton Forge, Virginia.

The scientific management of railway shops is no more or less than the saving of unnecessary waste in time and material; or we might say, decrease the cost and increase the output. In order to show what is being done in this direction, I will describe the method in which brake beam hangers are being manufactured at the above named shops, at what we consider the very low cost of one and one-half cents each. The cost, however, does not include shearing the stock to length and handling the finished product to material bins.

The services of two men are employed: namely a machine operator and a heater. The stock is cut to length to suit the length of hanger desired. It is then heated and bent in a "U" shape, as shown in operation number one. It is again heated to a sufficient length at points marked A A, and both eyes are then bent in an opposite direction. In other words, the hanger is completed with two heats and three operations. This work is accomplished on a machine shown in the illustration. It was built in the shops at this point, and consists of a cast iron off-set slab plate, to which are securely fastened two air cylinders (one cylinder is only used in the manufacture of brake beam hangers, the other being underneath the slab plate and used for other purposes). The machine is equipped with a system of



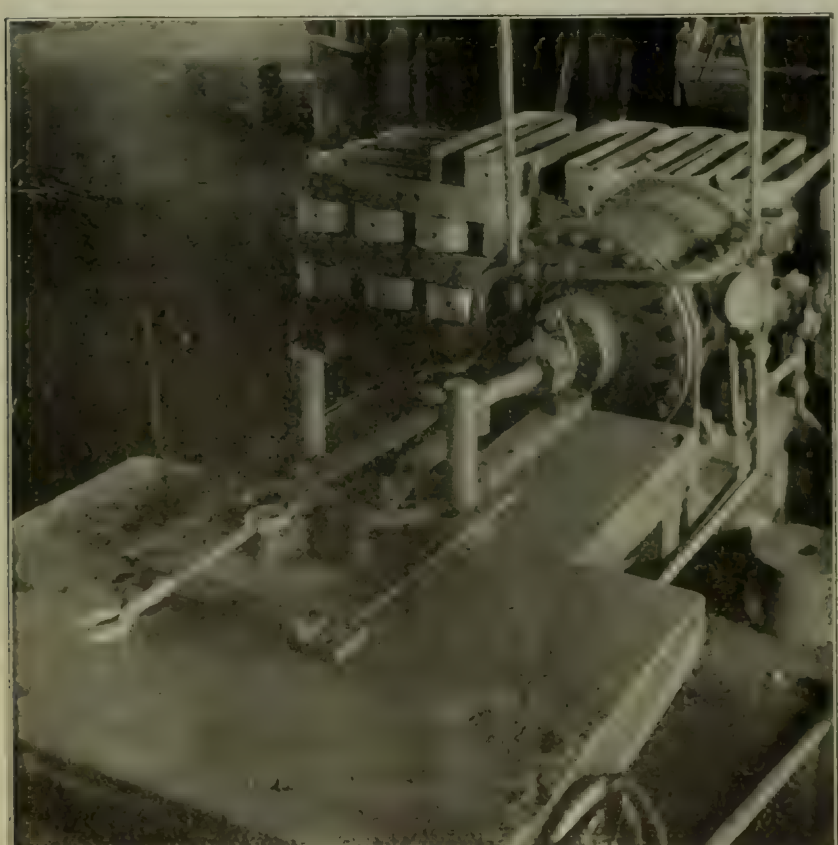
Plan of Bending Machine.



Bending Machine With "U" Former in Place

operating levers, which makes it very handy for the operator. The bending formers can be removed in an instant by simply lifting them off of the pins marked "B" "B." An air hose is also provided to remove the scale accumulation from the formers. The heating forge is located close by the bending machine. The general make-up of the machine can be observed by referring to the illustrations, and while I have visited a good many of the railroad smith shops throughout the country, I think this machine equally as good, if not better, than any I have ever been able to see. I would consider it a valuable machine to have in any railroad shop, as it can be used to great advantages in manufacturing coupler yokes, etc.

The surprisingly low cost of the manufacture of brake beam hangers was made possible only by the manner in which our smith foreman, R. L. Woodrum, applied himself to the study of the subject of cost reduction and increased output, which should be the disposition of all foremen who are in the service of the railroad companies. I would like to say also that the statement was made in one of the technical journals some time since to the effect that brake beam hangers were made at the Cleveland shops of the Erie at a cost of five cents each, which in my opinion is very high.



Bending Machine With Eye Formers in Place.

The photographic illustrations show that the eyes were bent on the hanger before the hanger was bent into "U" shape. This is incorrect and a reversal of the usual procedure. The error was made in arranging the machine for photographing.

WHY A ZINC COATING IS THE BEST RUST PREVENTIVE FOR IRON OR STEEL.

It is difficult for many persons to understand why zinc is the best rust preventive for iron or steel, and they believe it is on account of its cheapness that it is so extensively used. They have an idea that lead, being a cheaper metal, would answer far better, and as it is more non-corrosive than zinc, would protect the iron better. This is not a fact, however, as will subsequently be explained.

The very fact that zinc is corrosive metal does not affect its properties when applied as a coating to iron or steel. Indeed, if it did not corrode, it would not be of value for such a purpose. When iron or steel which has been coated with zinc is exposed to the atmosphere, a galvanic action is set up, although, of course, extremely slight. Any two dissimilar metals form a galvanic couple, but as zinc is the most electro-positive metal, the galvanic action between the zinc and iron is as great as could be obtained when iron is used for one of the metals composing the couple.

The result is, therefore, that with the slight galvanic action set up on galvanized iron or steel, when exposed to the atmosphere, a corrosion takes place. Did it not follow, then, there would be no protection. In this case, the zinc, being the electro-positive metal, suffers corrosion at the expense of the electro-negative metal iron. The effect is that the corrosion goes on with the zinc exclusively and iron is not corroded at all, provided any zinc is left on the iron or steel. This condition takes place whether a light or heavy coating of zinc is present. The only advantage of a heavy zinc coating is that it will last longer, but under ordinary atmospheric conditions, where a slight amount of moisture is the only exciting liquid, the galvanic action is very small, and the zinc coating, be it ever so light, lasts a long time. In the case of sea water or air saturated with salt moisture, the corrosion, of course, is much more rapid, and a heavier zinc coating is required to resist it for a length of time.

The reason for the protection of iron or steel by a zinc coating is, therefore, on account of the fact that the zinc corrodes at the expense of the iron or steel by the galvanic action set up. Zinc, however, when exposed to the air, does not corrode rapidly or deeply, and, in fact, very lightly. This property is of great value, as the zinc coating does not corrode rapidly, even with the galvanic action set up, so that it lasts for a far greater length of time than would naturally be expected. The very fact, however, that the zinc corrodes at the expense of the iron is all that is necessary to protect the iron or steel, even though it be extremely slight.

Other metals like lead or tin, on account of their not being electro-positive to iron, do not act like zinc. They act simply as a covering like a paint or varnish, and if portions of the iron happen to be exposed, even such as a pinhole, the iron begins to corrode. With a zinc coating, however, this will not take place.—*Brass World.*

The Railway Business Association held its annual meeting at the Waldorf-Astoria Hotel, New York, on December 11, 1913. At the dinner two addresses were made, one by Howard Elliott, of the New York, New Haven & Hartford, and one by Governor Cox, of Ohio. There were over a thousand in attendance at the dinner.

Locomotive Boiler Inspection*

By Frank McManamy, Chief Inspector, Division of Locomotive Boiler Inspection, Interstate Commerce Commission

When the locomotive boiler inspection law was passed by Congress, it was looked upon with considerable apprehension by most railroad officials, and many dire prophecies of its effect on the railroads were made.

The prevailing impression at that time appeared to be that the law was impractical and unnecessary; that it would cost the railroads an immense sum of money and would benefit no one. Although the comparatively brief time it has been in force has not been sufficient to fully demonstrate all the benefits to be derived from its provisions, it is evident that the two and one-half years' experience with the law has materially changed the feeling towards it, and, I believe, has fully vindicated the motive of those who urged its passage, the wisdom of those who enacted it, and, I hope, has demonstrated the fairness of those who are charged with the duty of enforcing it.

It could not reasonably have been expected that the enforcement of a law so far-reaching as the locomotive boiler inspection law, governing as it does the condition of the motive power which is the very life of one of the most, if not the most, important industries of the country, could have been effected without some friction and some opposition. Neither could it reasonably be supposed that the conditions which, in the minds of those who urged it and those who passed it, made the law necessary, could be remedied without some expense. Nor could we expect that the uniformity of practice and of equipment which, local and service conditions considered, are so essential to safety, could be brought about without sacrificing some of our pet ideas or changing some practices whose chief claim to superiority lies in the fact that they have been in use a certain number of years.

The fact that the locomotive boiler inspection law on the whole has been beneficial to the railroads as well as to their employes is now being generally admitted, and for that reason it is not my purpose tonight to spend time in discussing its value, because I believe that has been abundantly demonstrated; therefore, I will tell you first some of the things that have been accomplished by it, and will then analyze a few of the accident reports in order to show, if possible, some of the things that must be given attention in order to further promote safety.

* A paper delivered before the Western Railway Club.

The accident records show that during the year ended June 30, 1913, there was a reduction of over 60 per cent in the number killed and ten per cent in the number injured by failures of locomotive boilers and their appurtenances, in comparison with the preceding fiscal year, or with any previous year of which a reasonably authentic record exists, and this, in my opinion, amply justifies every requirement of the law.

The practice of conducting a rigid, searching investigation of all accidents to locomotive boilers and their appurtenances sufficiently serious to justify a report, with the sole object in view of determining the exact cause and having the proper remedy applied, has done much to reduce the list of casualties and has directed attention to conditions which previously have been overlooked or ignored. The knowledge that such an investigation will follow every accident is an incentive to the railroad companies to maintain their equipment so that its condition can not be shown to have caused accidents, and is also an incentive to the employes to perform their work in the most efficient and careful manner.

The period since the law became effective has been too brief to permit a comparison to be made which will accurately show its value. It is believed, however, that in addition to the comparison of the total number of injuries during the year ended June 30, 1913, with the preceding fiscal year, the following comparison of some of the most serious, as well as some of the most frequent, accidents during the first and last quarters of the fiscal year ended June 30, 1913, fairly represents the benefits which result from government supervision over the condition of locomotive boilers and their appurtenances:

	First Quarter			Last Quarter		
	Accidents	Killed	Injured	Accidents	Killed	Injured
Crown sheet failures	18	10	30	9	2	13
Flue failures	15	..	18	11	1	11
Injector steam pipe failures	10	..	13	5	..	6
Arch tube failures	5	..	5	5	..	7
Water glasses bursting	36	..	36	16	..	16
Lubricator glasses bursting	11	..	11	6	..	6

It will thus be seen that for the six classes of accidents referred to above which resulted in injury, 95 occurred during the first quarter and 51 during the last quarter.

A better illustration, perhaps, of the improvement which has been brought about is that during the three months ended September 30, 1912, there were 95 accidents of the classes mentioned above, with 10 persons killed and 113 injured thereby,

A Boiler Shell Which Was Blown Several Hundred Feet From the Scene of the Explosion.

Other Side of Boiler Shell Shown on Preceding Page.

while during the six months ended September 30, 1913, there were 94 accidents, with eight killed and 103 injured thereby.

A brief digest of some of the more serious accidents shows a very decided improvement on the whole, but there are certain classes of accidents where, instead of an improvement, conditions appear to have grown worse. One illustration of this is the arch tube failures. During the year ended June 30, 1912, there were 18 arch tube failures which caused injury, with none killed and 23 persons injured thereby, and during the year ended June 30, 1913, there were 20 arch tube failures which caused injury, with three killed and 27 injured thereby.

Investigation shows that of these 20 arch tube failures, 15 were caused by improper application or neglect; one showed evidence of both; three were reported to have been defective, and only one showed a clear rupture without evidence of improper application, neglect, or defect in the tube. This proves conclusively that with proper attention 80 per cent of these accidents could have been positively prevented, particularly in view of the fact that these failures did not occur immediately after the application of the tube, but in each case one or more subsequent inspections had been made and certified to, stating that the tubes were in good condition, when, as a matter of fact, they had not been properly inspected.

It will, no doubt be urged that the increase in the number of locomotives in service which are equipped with arch tubes may account for the increased number of accidents, but as it has been shown that four out of every five arch tube failures result from improper application or neglect, they can not properly be charged to the increased number of tubes in service.

Tightening washout plugs under pressure is a practice which has caused numerous accidents, and a peculiar fact in connection with it is that in a majority of such cases this work was being done with the boiler foreman or roundhouse foreman present and either directing or performing the work. This class of accidents is positively preventable, and strict instructions should be issued and enforced never to put a wrench on a plug while there is pressure on the boiler.

Another type of accidents which has shown an increase during the past fiscal year is injector steam pipe failures.

During the year ended June 30, 1912, there were 31 accidents of this type which caused injury, in which 38 persons were injured.

During the year ended June 30, 1913, there were 36 accidents of this type which caused injury, in which 47 persons were injured.

In 24 cases the failure occurred where the collar was brazed on to the pipe and was due either to defective brazing or to the fact that the pipe or the collar was too thin at this point. This is a defective condition which could not readily be discovered by inspection, but the fact that such failures invariably occurred at the same point should have led to an investigation that would have disclosed the cause. That this was not done is doubtless due to the fact that until the passage of the locomotive boiler inspection law there was no central organization by which all boiler accidents were investigated and where necessary data could be compiled showing conclusively where the weakness lay, and that is one important duty that the federal locomotive boiler inspection service is trying to perform.

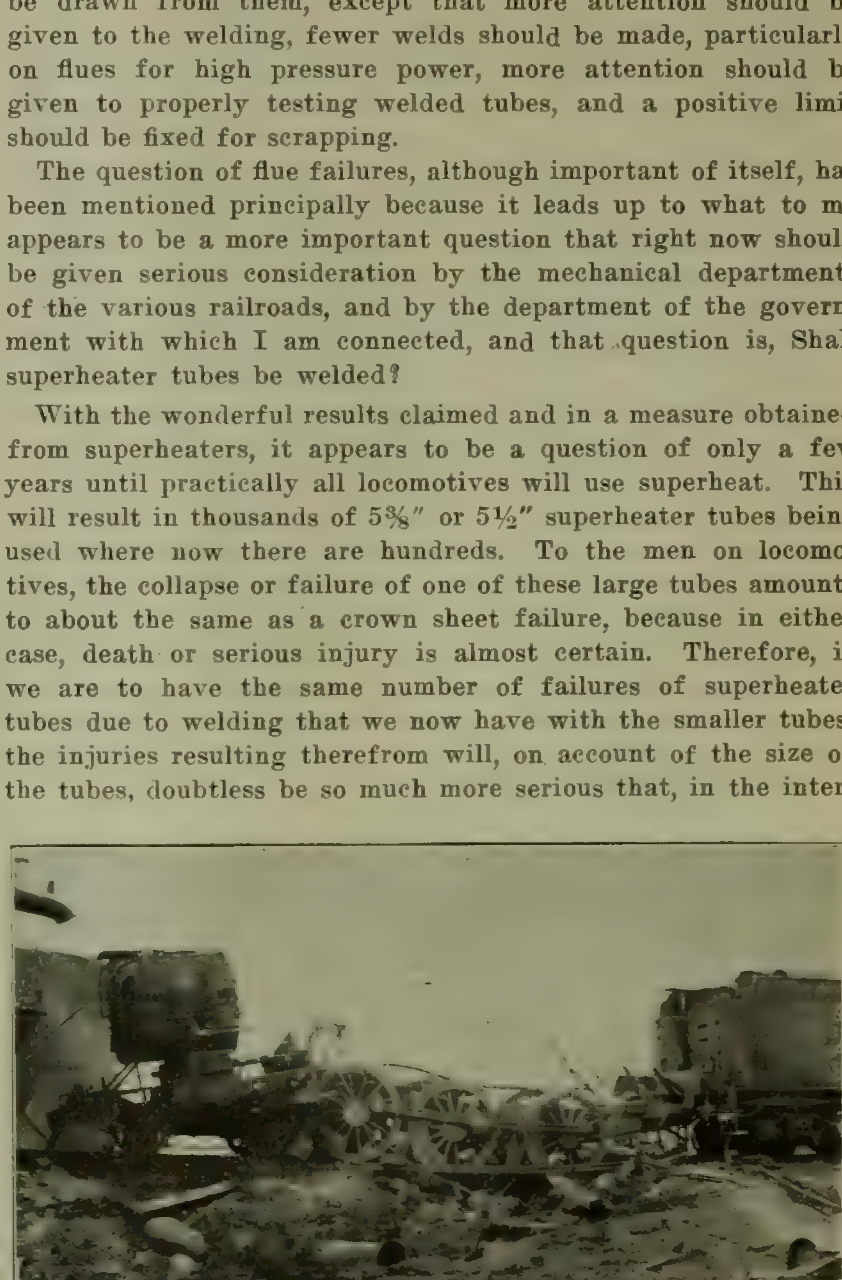
In order that this condition may be properly remedied at its source, we have directed the attention of injector manufacturers and locomotive builders to this weak point, and they are at the present time earnestly striving through the efforts of a joint committee with which we are co-operating to have adopted a connection that will remedy the trouble. It is believed that a better connection has been designed and will be used on all new work, but it will require some time to change the thousands that are now in service; therefore, until that time comes, extreme care should be exercised in brazing these joints, and such work should not be done except at points where there are proper facilities and competent men to do the work.

Another class of accidents in which there has not been an improvement is flue failures. During the year ended June 30, 1912, there were 56 failures which caused injury, resulting in one killed and 62 injured, and during the year ended June 30, 1913, there were 54 failures which caused injury, resulting in one killed and 63 injured.

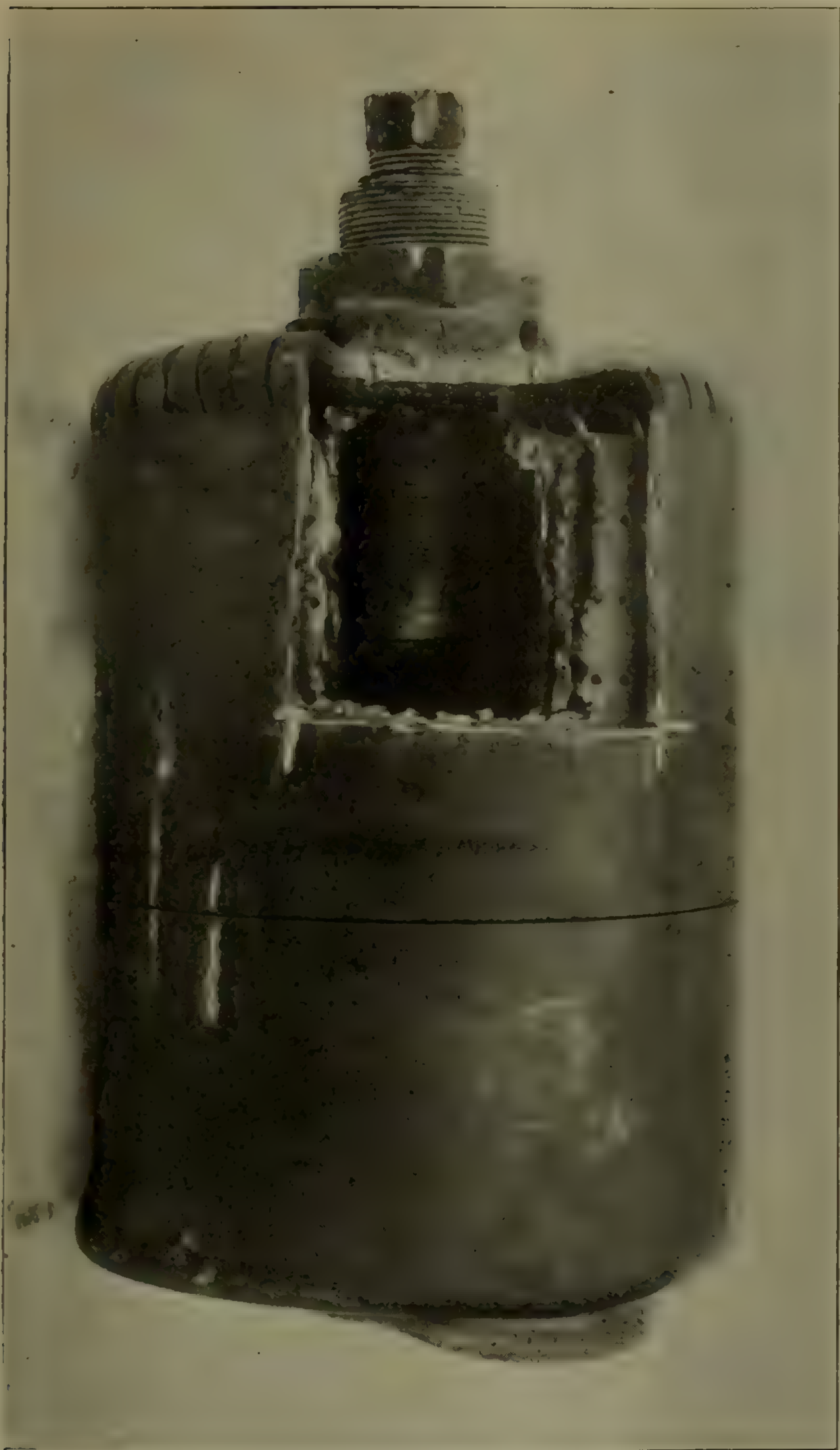
The results thus shown are so nearly equal that no lesson can be drawn from them, except that more attention should be given to the welding, fewer welds should be made, particularly on flues for high pressure power, more attention should be given to properly testing welded tubes, and a positive limit should be fixed for scrapping.

The question of flue failures, although important of itself, has been mentioned principally because it leads up to what to me appears to be a more important question that right now should be given serious consideration by the mechanical departments of the various railroads, and by the department of the government with which I am connected, and that question is, Shall superheater tubes be welded?

With the wonderful results claimed and in a measure obtained from superheaters, it appears to be a question of only a few years until practically all locomotives will use superheat. This will result in thousands of 5⅜" or 5½" superheater tubes being used where now there are hundreds. To the men on locomotives, the collapse or failure of one of these large tubes amounts to about the same as a crown sheet failure, because in either case, death or serious injury is almost certain. Therefore, if we are to have the same number of failures of superheater tubes due to welding that we now have with the smaller tubes, the injuries resulting therefrom will, on account of the size of the tubes, doubtless be so much more serious that, in the inter-



Accident Where Entire Crown Sheet Came Down, Killing Two Persons and Seriously Injuring One. The Locoomtive Was Being Used as a Stationary Boiler.



Safety Valve Casing Showing Condition of Adjusting Screws. This Valve Caused an Explosion.

est of safety, action will have to be taken possibly even to the extent of prohibiting welds in such large tubes.

Do not misunderstand me in this. I am not making a positive statement that welds in superheater tubes will be prohibited, but that it is a matter which is being closely watched, and what action may be necessary will depend on future developments, because a large percentage of such tubes now in service are comparatively new and have never been safe ended. Many shops where this work is being done are poorly equipped for handling it; adequate tests of welded tubes are in many instances not being made; and, as might be expected, there is a wide divergency of opinion as to the best method of doing such work. That the strength of a weld is practically an unknown quantity has been demonstrated times without number. The fact that a number are tested and found good is not an indication of what the next one will do, and, for this reason, it is the generally recognized practice that where the highest degree of efficiency and reliability is required, welds are prohibited. It is the general practice not to permit the use of welded radials or other boiler stays. Almost all roads prohibit welding arch tubes. Safety appliance standards prohibit the use of welded brake shafts, yet in none of these things is reliability more essential nor failure more disastrous than in superheater tubes.

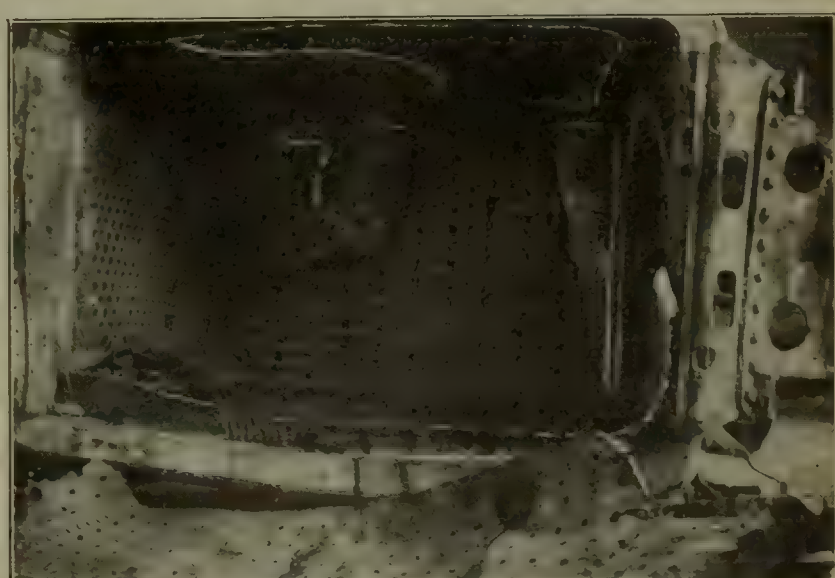
A short time ago the question was brought up by some of the railroads as to whether they would be required to remove superheater tubes once in three years in accordance with rule 10, which provides that "All flues of boilers in service, except as otherwise provided, shall be removed at least once every three years and a thorough examination shall be made of the entire interior of the boiler." It was urged that their superheater tubes should be exempt from that requirement on account of being welded in and also because their boilers could be entered, thoroughly cleaned and inspected as required by the rule, without removing the superheater tubes. Careful consideration was given to the reasons on which their request was based and also to what to us seems to be a more important point which was not advanced, viz., that the removal of such tubes would in all probability result in their being safe ended and put back; therefore, to avoid that contingency and to remove, so far as possible, the occasion for welding these tubes, as well as for the reasons advanced by them, it was decided that: "Unless further investigation should prove that it is necessary to do so, superheater tubes need not be removed every three years, provided the tubes are in good condition and the boiler can be thoroughly cleaned and inspected without their removal."

This privilege may not prove to be of as much importance as may at first appear, for the reason that present indications are that, except in rare instances, the life of such tubes will not exceed three years.

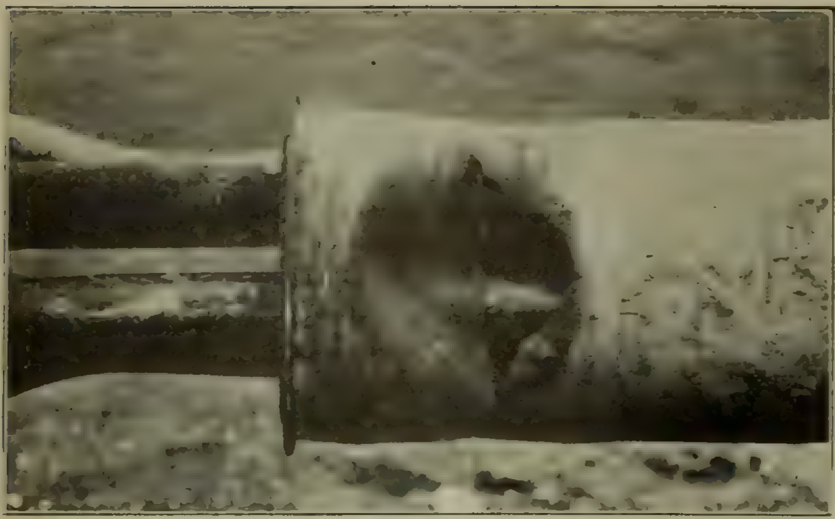
Another question of considerable importance, which has recently been decided, relates to the removal of brick work in oil-burning locomotives, for the purpose of hammer-testing staybolts. This is an expense which should, if possible, be avoided, yet not at the risk of continuing locomotives in service with broken staybolts. Although bolts usually break next the outside sheet, it is not always the case. Therefore, it has been considered necessary in all rules for inspection to supplement the use of the telltale hole by the hammer test. It is believed, however, that if bolts behind brick work have a telltale hole their entire length, sufficient protection against broken bolts will have been provided. Therefore, when this question was taken up by some of the carriers, they were advised as follows:

"If staybolts which are behind brick work on oil-burning locomotives, or behind grate bearers, have a telltale hole 3/16" in diameter their entire length, which is kept open at all times, the removal of the brick work or grate bearers each month for the purpose of hammer-testing such bolts, will not be required. This will not, however, relieve from making a thorough inspection each time the brick work is removed, nor will it relieve from removing the brick work for an inspection when necessary."

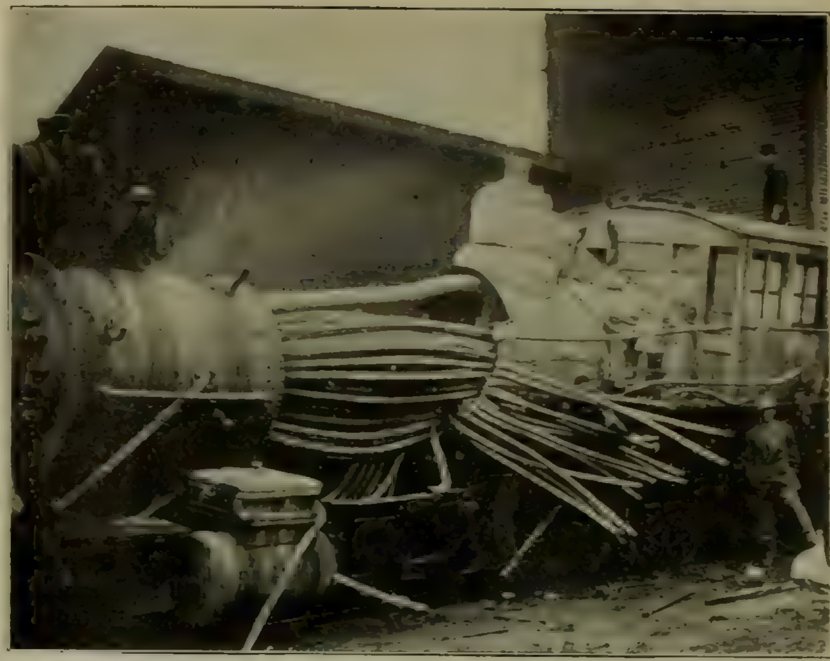
There still appears to be some requirements of the rules which are not fully understood, or, at any rate, are not properly complied with, to which I desire to direct your attention: One is that simply hammer-testing staybolts does not by any means constitute a complete monthly inspection in accordance with



Interior of Fire Box With Right Side Sheet Cut Away. The White Lines Denote the Burned Areas on the Crown Sheet and the Left Side Sheet.



Showing the Collapse of a Superheater Tube.



A Disastrous Explosion

the rules. Neither does the fact that a man has hammer-tested the staybolts of itself place him in possession of all the necessary information to enable him to properly certify to the inspection report; yet we find many instances of where the man who tested the staybolts certifies to the report when he has gone to some other point before the other work shown on the report was done, and as a matter of fact he does not know that it was ever done.

Every item that is shown on the monthly inspection report is a part of the inspection and must be performed in accordance with the rules; washing the boiler, cleaning gauge cocks and water glass cocks, testing and repairing injectors, repairing steam leaks, and inspecting arch or water bar tubes which can only be properly done when the boiler is washed, are just as much a part of the monthly inspection as testing the staybolts, and should be performed at the time the monthly inspection is made, and the man or men who certify to the inspection report must have knowledge that such work has been performed.

There also appears to be some doubt in regard to the proper construction of rules 30 and 36, relative to the interval between steam gauge and safety valve tests. This period is assumed by some to be anywhere between 90 and 120 days. This is a mistake. In order that there should be a certain degree of flexibility in the rules, they were made to read that this work should be done at least once every three months, which means approximately 90 days. The proper time to test steam gauges and set safety valves is each third inspection, and it should be done at the time the inspection is made, so that it may be properly certified to on the inspection report. If the monthly inspections are made at the required periods, they will automatically take care of the interval between the quarterly inspections.

Another matter that has not always received the consideration that it should is the location of the bottom water glass fitting. The opening to the boiler for this fitting should always be above the highest point of the crown sheet; yet on a large percentage of locomotives they appear to have been located without much regard for the height of the crown sheet, the proper height of the lowest reading of the glass being obtained by the use of nipples of various lengths. When this opening to the boiler is made below the highest point of the crown sheet, if the top water glass cock is closed or the opening restricted, water will show in the glass when there is none on the crown, and we have records which show that this has been the cause of more than one crown sheet failure; therefore, I desire to urge the importance not only of having the lowest reading of the glass the proper distance above the crown sheet, but also of having the fittings so applied that the glass can not under any circumstances show water when the crown is bare, and this means that the fitting should be so designed and located that the proper reading of the glass can be obtained and the opening to the boiler kept above the crown sheet. The necessity of carefully checking the location of water glasses and gauge cocks was forcefully demonstrated a short time ago when one of our inspectors found ten new Mikados which had just been received from the builders and placed in service with the lowest reading of the water glass just below the highest point of the crown sheet.

As a means of reducing the number of plugs to be removed when boilers are washed, the practice of blanking washout openings appears to be meeting with considerable favor on some

An Explosion Due to Defective and Insufficient Crown Bar Braces.

Arrows Point to Defects in Casting.

roads, although in a number of instances investigation disclosed the fact that it was being done by the local officials or inspectors without the knowledge of the chief of the mechanical department. It is doubtless true that in some instances, more washout openings than are actually needed have been provided, but we find that the opposite is more frequently the case, and, under such conditions blanking any of them is inviting trouble, yet we know this is being done. I believe the statement that more boiler failures are due to poor washing than to any other one cause can be demonstrated, and that there is no other way in which the mechanical department of any railroad can lay up so much future trouble for itself at such a small saving as by slighting the washing of boilers.

The matter of blanking washout openings will be watched as closely as possible and when sheets begin to show indications of distress vigorous action will be taken, and if it should come at a time when considerable inconvenience is caused thereby it would seem that neither the inconvenience nor the cost of the repairs could be properly charged to the operation of the law or the action of the inspectors.

A summary of the inspection work performed by the Division of Locomotive Boiler Inspection during the year ended June 30, 1913, discloses the following:

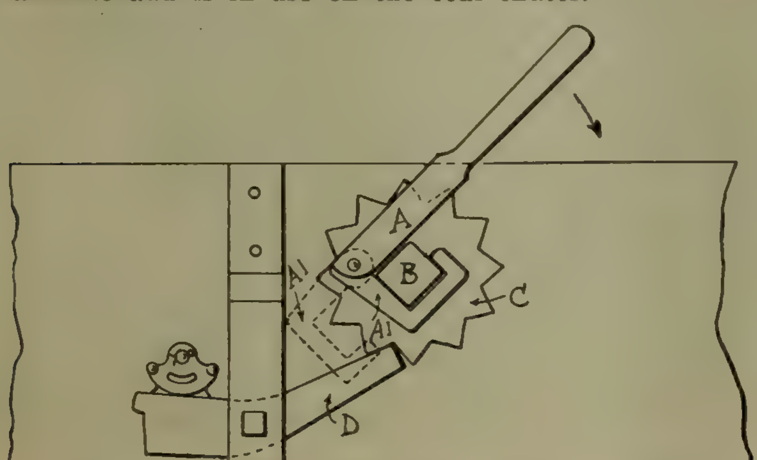
Number of locomotives inspected	90,346
Number found defective	54,522
Number ordered out of service	4,676

The number of locomotives found defective as shown above, viz., 54,522, does not indicate that this number of locomotives were found to be in violation of the law, but they were found to contain defects which should be remedied before the locomotives were again placed in service. The number found in direct violation of the law is represented by the number ordered out of service in accordance with Sec. 6 of the law, which requires the district inspectors to issue a written order holding the locomotive for repairs when one is found that does not meet the requirements of the law or rules. No formal appeal from the action of any district inspector has been filed during the year. This, in view of the vast amount of work performed and the number of locomotives on which repairs were ordered, shows that while the inspectors have been diligent, they have also used discretion and good judgment in the enforcement of the law. It is believed that it also shows the existence of a spirit of co-operation and an earnest effort to comply with the requirements of the law on the part of a large majority of railroad officials.

WRENCH FOR HOPPER CARS.

By J. A. Jesson.

The illustration shows a safety wrench for dropping the doors of hopper cars. The wrench consists of a body A and a knuckle A1, which, it will be noted, can swing into the position shown by the dotted lines. After releasing the pawl and giving the shaft a partial revolution the wrench will be released. With a solid wrench there is always danger that it will hang and fly off if the shaft revolves rapidly. The wrench was devised by the bridge and building department of the Louisville & Nashville and is in use on the coal chutes.



Wrench for Hopper Cars.

NEW LOCOMOTIVES, GRAND TRUNK RAILWAY

The two types of eight-coupled locomotives which are most commonly used in the United States are the consolidation (2-8-0) and Mikado (2-8-2). Service conditions must decide which of these two shall be employed for any given class of work. The Mikado type, because of its high relative steaming capacity, is on many roads replacing the consolidation in heavy through traffic, and is proving most successful; but the consolidation is still employed to excellent advantage in service which is within its capacity.

The Grand Trunk Railway has recently placed in service twenty-five Mikado and three consolidation type engines, which were built by the Baldwin Locomotive Works. All these locomotives are equipped with superheaters. The consolidations are used on the Detroit and Toledo Shore Line, which is comparatively level, and they are well adapted to the conditions on this division. They have a considerably higher ratio of adhesion than the Mikado type locomotives, but their relative steaming capacity is lower, as the following data show:

	Mikado Type	Consolidation Type
Weight on drivers, pounds	204,700	190,600
Tractive force, pounds	51,800	38,600
Ratio of adhesion	3.95	5.18
Total equiv. heating surface (sq. ft.)	4,804	3,030
Cylinder volume, 2 cylinders (cu. ft.)	19.9	14.4
Equivalent heating surface (Cylinder volume)	242	210
Tractive force (Equivalent heating surface)	10.6	12.7

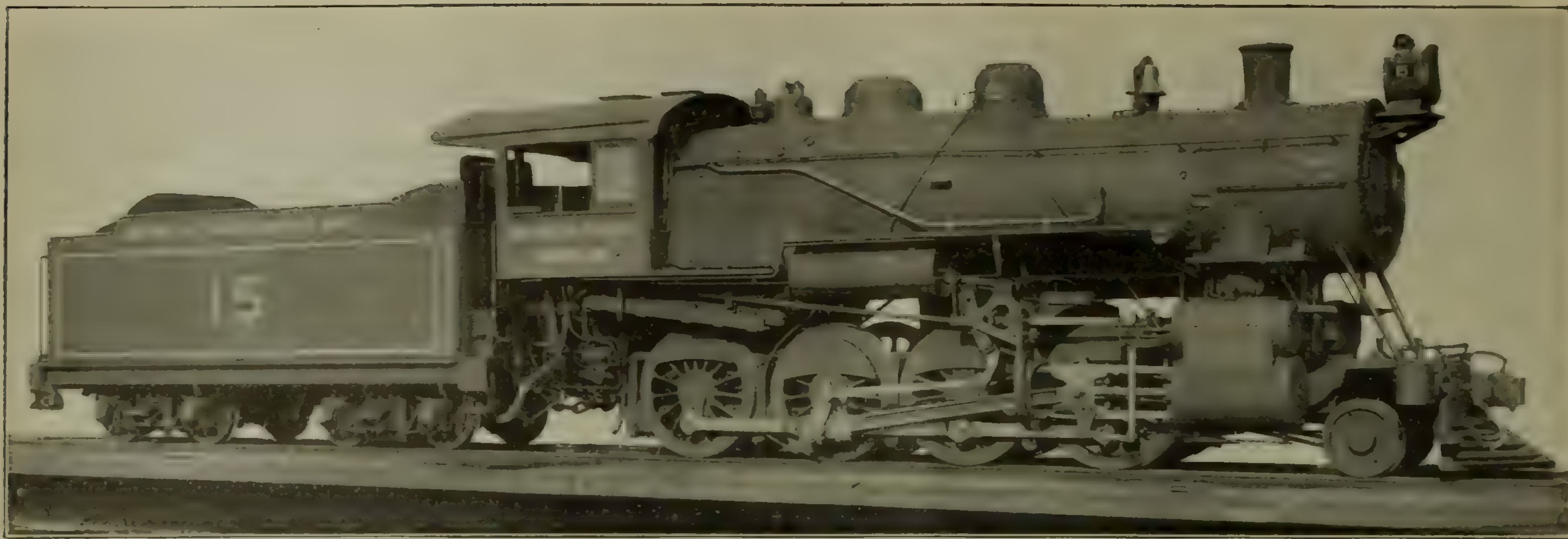
In proportion to the cylinder volume, the heating surface of the Mikado type locomotive is 15 per cent. in excess of the consolidation; while in proportion to the tractive force, the increase is 20 per cent. In making this comparison each square foot of superheating surface is assumed to be equivalent to 1½ square foot of water heating surface.

The two locomotive designs have many features in common. The boilers are of the extended wagon-top type with wide fireboxes, and they are equipped with brick arches and pneumatically operated fire doors and grate shakers. In the Consolidation type, the mud-ring is sloped sufficiently to secure a furnace throat 20 inches deep, thus providing room for the foot of the arch between the grate and bottom row of tubes. The depth of throat in the boilers for the Mikado type locomotive is 26⅜ inches. In both classes the dome is of pressed steel made in one piece. This style of dome is strong and light, and is proving satisfactory in every way.

All these locomotives have 14-inch piston valves, which are of the built-up type with cast iron bodies and bull rings, and malleable iron heads. The packing rings are of Hunt-Spiller gun iron, and this material is also used for the piston packing rings, and the cylinder and steam-chest bushings. The valves are driven by Walschaert's motion. The link and reverse-shaft bearings, on each side of the locomotive, are combined in a single casting which is bolted to the guide yoke. The Mikado type engines are equipped with a screw reverse, while the usual lever is applied to the consolidations.

The frames used in both classes are of vanadium cast steel, with single front rails under the cylinders. The Mikado type locomotives have the Cole design of main driving-box, with 11"x20" journals. With this construction, strong transverse braces are applied at the main pedestals. The frames are also braced transversely midway between adjacent driving axles. The front frame sections, under the cylinders, are made with downwardly projecting lugs, and to these is bolted a steel casting which supports the driving brake shaft and the radius-bar pin for the front truck.

The tender frames for both classes have 13-inch channels for the center sills and 10-inch channels for the side sills. The wheels are of forged and rolled steel. Those used under the tenders for the consolidation engines have vanadium con-



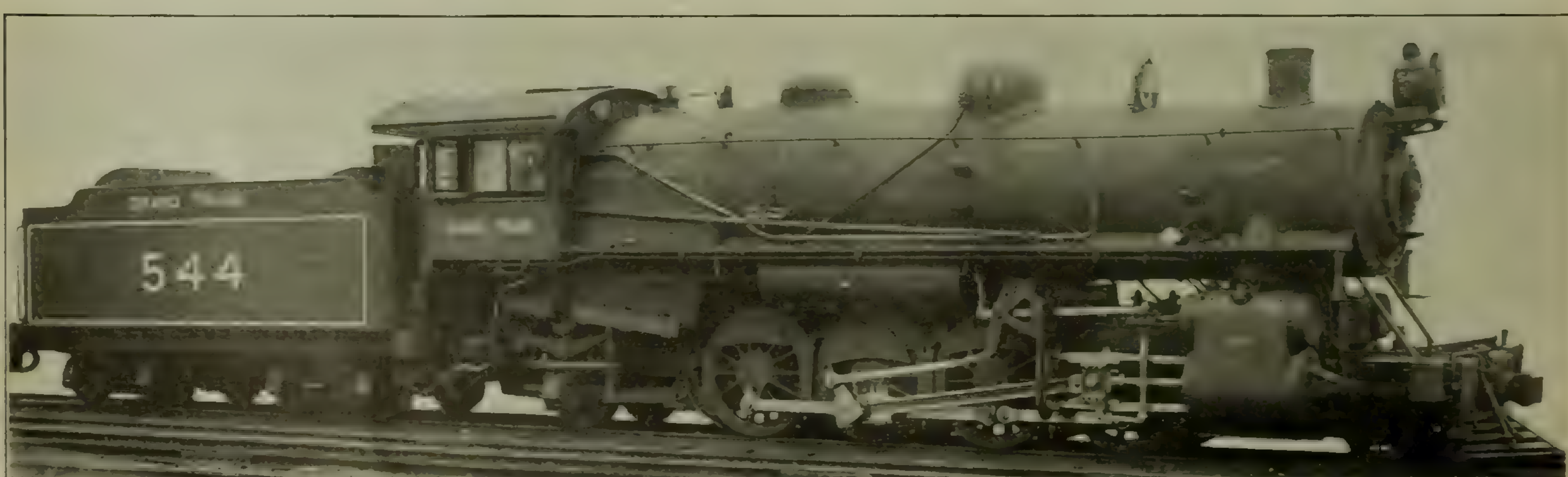
Consolidation for the Grand Trunk Railway System.

tent. while in the case of the Mikado type locomotives the tender wheels are heat treated.

The tables contain the principal dimensions of these two types of locomotives.

	Consolidation		Mikado
Gauge	4'-8½"		4'-8½"
Cylinders	23"x30"		27"x30"
Valves	Piston, 14" diam.		Piston, 14" diam.
Boiler—			
Type	Wagon-top		Wagon-top
Diameter	68⅜"		74"
Thickness of sheets	11/16 & 25/32"		¾" & 13/16"
Working pressure	180 lbs.		175 lbs.
Fuel	Soft coal		Soft coal
Staying	Radial		Radial
Fire Box—			
Material	Steel		Steel
Length	96⅞"		108"
Width	75¼"		75¼"
Depth, front	72¾"		85⅞"
Depth, back	56¼"		68⅜"
Thickness of sheets, sides	⅜"	sides	⅜"
Thickness of sheets, back	⅜"	back	⅜"
Thickness of sheets, crown	⅜"	crown	⅜"
Thickness of sheets, tube	½"	tube	½"
Water Space—			
Front	5½"		5½"
Sides	4½"		4½"
Back	4½"		4½"
Tubes—			
Material	Steel		Steel
Diameter	5⅜" & 2"		5⅜" & 2"

	Consolidation	Mikado
Thickness	5⅜", 0.150"	5⅜", 0.150"
	2", 0.125"	2", 0.125"
Number	5⅜", 26; 2", 207	5⅜", 32; 2". 240
Length	15'-0"	20'-0"
Heating Surface—		
Fire box	165 sq. ft.	219 sq. ft.
Tubes	2162 sq. ft.	3400 sq. ft.
Firebrick tubes	28 sq. ft.	31 sq. ft.
Total	2355 sq. ft.	3650 sq. ft.
Grate area	50.6 sq. ft.	56.5 sq. ft.
Driving Wheels—		
Diameter, outside	63"	63"
Diameter center	56"	56"
Journals, main	9½"x12"	11"x20"
Journals, other	9"x12"	10"x12"
Wheel Base—		
Driving	17'-0"	16'-6"
Rigid	17'-0"	16'-6"
Total engine	25'-9"	35'-1"
Total engine & tender	57'-3¾"	67'-6¾"
Weight—		
On driving wheels	190,600 lbs.	204,700 lbs.
Total engine	215,200 lbs.	272,100 lbs.
Total engine & tender, about	370,000 lbs.	443,000 lbs.
Tender—		
Wheels, number	8	8
Wheels, diameter	34"	34"
Journals	5½"x10"	6"x11"
Tank capacity	8,000 gals.	9000 gals.
Fuel capacity	10 tons	15 tons
Service	Freight	Freight



Mikado for the Grand Trunk.

LEONARD SHOPS, NATIONAL TRANSCONTINENTAL RY.

The general layout of the repair shops of the National Transcontinental Railway at Quebec, P. Q., shows that not only has convenience of operation been the general principle governing the design, but future needs have also been provided for. Each shop is capable of extension without interfering with any other and any department can be increased separately as occasion may require.

There are eleven buildings in all, of various dimensions, each suitable for the special work to be done in it. These buildings consist of a locomotive, erecting, machine and boiler shop (under one roof), forge shop, freight car shop, power house, planing mill, dry kiln, store, lumber shed, forge stores and scrap bins, oil house and office building for executive staff. The total area covered is about five and one-half acres.

In the erecting shop there are eighteen pits, placed transversely, over which a 120-ton crane lifts locomotives into, and removes them from, their respective positions. A 20-ton crane operates over the same area at a few feet lower level and carries small material and makes many light and rapid lifts.

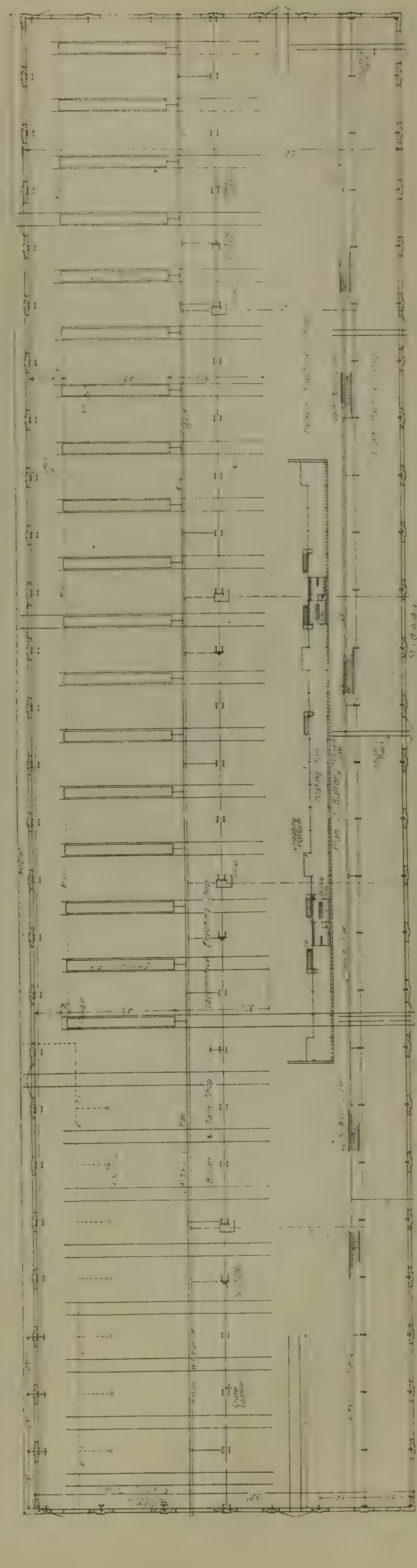
The "transverse-pit layout" has the advantage of doing away with many side doors in the building for the "in-and-out" movement of locomotives. There are two doors, conveniently placed, through which engines and material enter and leave. This arrangement is economical in the matter of heating. It does away with the necessity of a transfer-table with all its inconvenience from snow and ice. The practically unbroken sidewall permits the use of jib cranes, one serving the fronts of two locomotives, being capable of lifting smokestacks, main valves, smoke box doors and rings, etc., etc. The use of these very handy cranes would be most difficult if the wall of the shop had been cut up into a series of doors.

The cross-section of the shop shows the position of the cranes. The large crane is carried on a series of built-up columns, so that the heavy load is central over the line of foundations. As one crane does the work of lifting and placing each locomotive, there is no chance of confusion such as might occur when two cranes are used and where two men do the work. The single powerful crane has also the advantage over the usual twin crane arrangement in economy of first cost and maintenance.

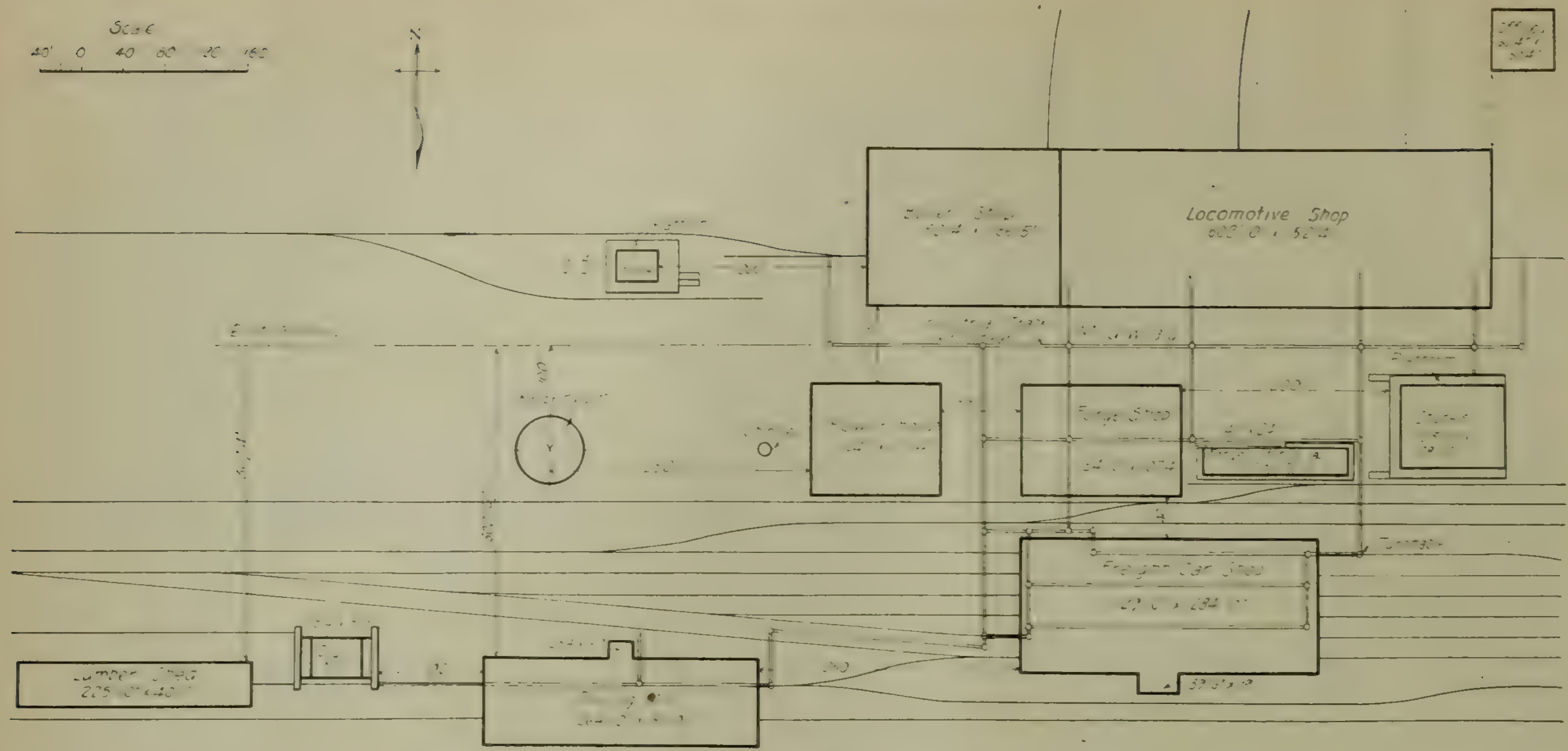
All the overhead cranes are provided with effective safety appliances. One of the most important prevents the load from being "over-wound" by the lifting drum, either by accident or otherwise. It consists of a device which, when the maximum lift has been reached, automatically opens a switch on the hoisting circuit and so cuts off the current, thus suddenly removing the driving power. The cessation of the current immediately brings into powerful action a gravity operated brake, which is normally held out of service by the flow of current.

The direction in which the midway crane operates is a new departure in railway shop construction, which has been brought out by W. J. Press, mechanical engineer of The Commission, and it secures substantial advantages. The midway is laid out so as to be alongside of the shops and not at the ends of the buildings as is frequently the case. The object of this arrangement is that when material is brought by the midway crane from the storehouse, forge shop or foundry to the machine, erecting or boiler shop, it is placed at the door nearest to the machine on which the material will be handled, or to the engine upon which it will be used. In this way the delivery of material is not concentrated at one spot at the extreme end of the building. It avoids distribution from a congested area, and it obviates the "long haul" through the shop. Material is laid down at a point as near as possible to its destination, and economy of time and labor, as well as facility in handling, is thus secured.

The system of placing machines is such that the movement of material will be in one direction and the distance over which any locomotive "part" is carried will not be unnecessarily lengthened by journeys forward from one machine and back



Layout of Erecting Shop of National Transcontinental Ry. at Quebec.



General Layout of Leonard Shops, National Transcontinental Ry.

to another. The continuous one-way movement of material saves time and labor and prevents interference.

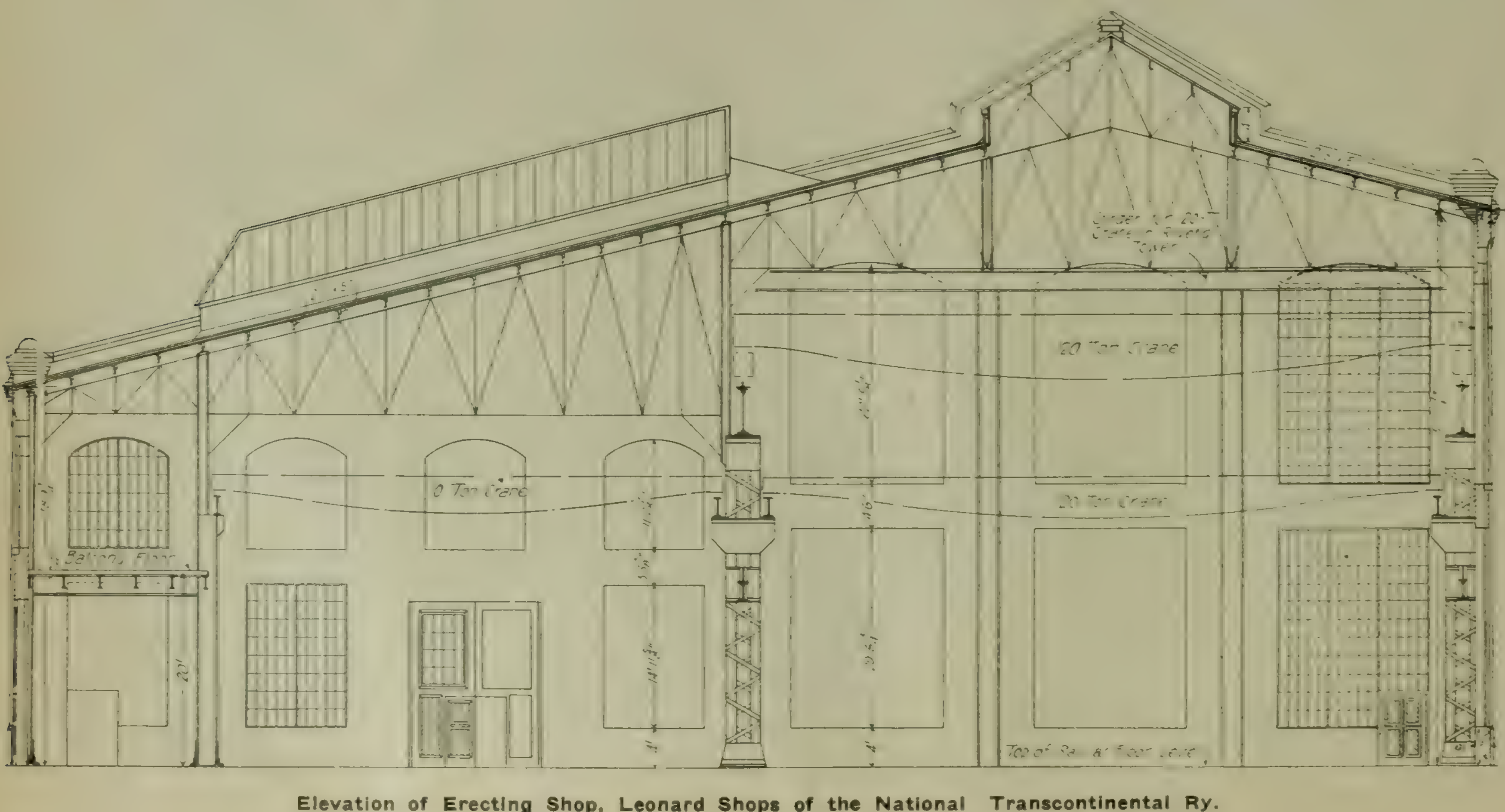
The pits in the locomotive shops are supplied with steam, compressed air, hot and cold water. Depressions in the pit walls carry the pipes. By this arrangement the working space in the pits is not restricted and the pipes are not where they can be easily damaged by workmen dropping material on them, and thus while being quite safe, they are out of the way.

The forge shop and the boiler shop are placed as near as possible to the power house. This is important, for in the case of the forge shop, where hammers are operated by live steam, the short distance between boiler and hammer reduces condensation and delivers steam where it is required with small loss. A similar condition holds good in a sense, for the delivery of compressed air to the boiler shop machinery. The nearer the source of supply, the less the pipe friction involved and the smaller the losses due to the forcing of air through the pipes.

Industrial tracks form convenient means of communication between the various shops. The buildings, cars, engines and supplies are protected by a water-system arranged to be readily put in use in case of fire. A further protection is afforded by reason of the use of concrete and steel in the various structures.

The shops are situated at Quebec and have been named after Major R. W. Leonard, chairman of The National Transcontinental Railway Commission, under whose administration they were projected. The outlay has been carefully supervised so that excellent results will be attained and full value received for the money expended.

The whole plant has been laid out under the supervision of



Elevation of Erecting Shop, Leonard Shops of the National Transcontinental Ry.

Gordon Grant, chief engineer, in such a way that the latest and most modern railway practice has been provided for, and the design will be second to none in the country.

The permanent and substantial character of the shops and the size of the whole plant will be of material advantage to the city of Quebec by providing steady employment for a considerable number of men the year round. The contract for this important piece of work was awarded to Joseph Gosselin of Pt. Levis, Que.

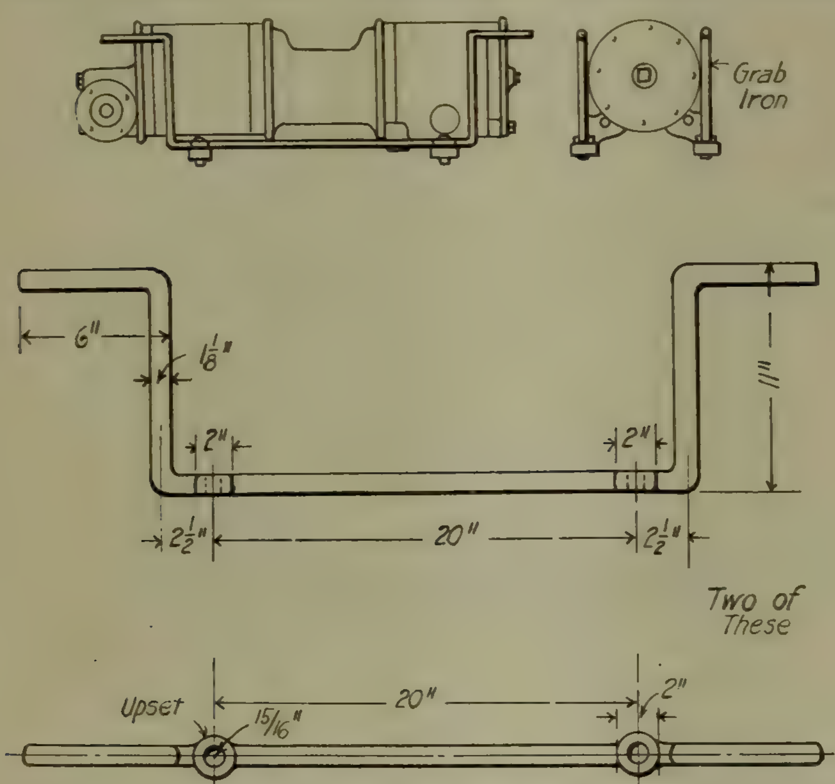
The design and laying out of the plant, the relative size, arrangement and position of the buildings and the selection of the machinery and appliances has been entrusted to W. J. Press, mechanical engineer of The Commission, who has had charge of similar work at the Transcona shops of the National Transcontinental Railway near Winnipeg. The Transcona shops are now being operated and in general plan, kind and quality of equipment they are of the most up-to-date type. The Transcona and the Leonard shops when completed will embody the latest design and the most modern practice, enabling them to be operated with a very high degree of efficiency. Altogether they will form a most valuable addition to the second of the great national "cross-continent" highways of Canada.

SAFETY DEVICE FOR HANDLING AIR PUMPS DURING ROAD SHIPMENTS.

By F. W. Bentley, Jr.

The shipment of air pumps between main or division shops and outside roundhouse points is, of course, an expedient and a necessary practice in the maintenance of this part of the air brake equipment on any road. The 9½-inch pump, the most commonly used compressor, is under the best conditions an unwieldy part to handle safely, but when necessary to hurriedly load or unload them on or off a baggage car they are a sore proposition to the trainmen; and sometimes a dangerous one.

The above sketch is descriptive of two single handle irons which are readily bolted to the pump on its delivery from the



Handy Device for Handling Air Pumps.

shop, and which make its shipment a far safer and easier task for all who are forced to handle it during the course of its consignment. The handles on the repaired pump are then, of course, applied to the old pump and go back with it to the main shop.

"Safety first" is indeed a good slogan, and from the experience and in the opinion of the writer it cannot be incidentally more forcibly applied than in the use of the simple detachable grab irons for handling such pumps during their hurried train shipments from point to point on the road.

FREIGHT CAR REPAIRS

The cost of freight car repairs and the influence of light capacity cars on the cost of repairs is a very live subject today, and in view of this fact the following figures are of especial interest. These figures are authentic and are based on the operation of one of our large transcontinental roads for the fiscal years between June 30, 1904, and June 30, 1913, the former being the earliest date that complete data was available. The percentage of light capacity cars destroyed by accident to the total number destroyed by accident during the fiscal year 1907 and the fiscal year 1913 was as follows:

Capacity.	1907.	1913.
25 tons and under	65%	13%
30 tons	29%	78%
All over 30 tons	6%	9%

From the above it is evident that the light car contributed to the increased cost in the past. A larger proportion of 25-ton cars were destroyed by accident in 1907 than in any other year. The smaller proportion destroyed in 1913 was undoubtedly due to the fewer number handled. This is evident from the fact that in 1904 on this road 30 per cent of the cars owned were 25 tons and under, while in 1913 the percentage of 25-ton cars was .74 of 1 per cent. The percentage of 30-ton cars owned in 1904 was 40 and in 1913 it was 26.2.

The total cost for both repairs and renewals for the years 1904 and 1913 was as follows:

Per car owned—	
1904	$ 86.99
1913	107.84
Per freight car mile—	
1904	71c
1913	83c

These figures show an increase in the cost per car owned of 23.97 per cent and per freight car mile of 16.9 per cent. The cost increased, notwithstanding that the average age of equipment on this road is now somewhat less than formerly, the average age being 9.01 years in 1904 and 8.48 years in 1913. The proportion of steel equipment has also greatly increased, being 11.6 per cent in 1904 and 60.3 per cent in 1913, an increase of 48.7 per cent.

However, another factor also increased and that was the increase in the average capacity of the car. In 1904 it was 30.57 tons and in 1913 42.45 tons, an increase of 38.83 per cent. The average tare weight was 13.55 tons in 1904 and 17.55 tons in 1913, an increase of 29.81 per cent.

The cost on a basis of combining car movement with tons capacity and tare, representing use and size of equipment, and given on a basis of 1,000,000 miles per ton of capacity, was 89 cents in 1904 and 63 cents in 1913, a decrease of 29.22 per cent. The cost new per unit of equipment has also increased as reflected in cost at M. C. B. price per car of average capacity in 1904 and 1913, as follows:

For 1904—	
30-ton wooden box car	$ 647.50
Average tare weight, pounds	29,500
Cost per ton capacity	21.58
Cost per pound of tare	2.2c
For 1913—	
40-ton steel underframe car	$1,167.50
Average tare weight, pounds	35,100
Cost per ton capacity	29.19
Cost per pound of tare	3.33c

This shows an increased cost per ton capacity of 35.3 per cent, and an increased cost per pound of tare of 51.4 per cent.

The cost for repairs and renewals based solely on capacity and tare were:

	Per ton of capacity	Per ton of tare.
1904	$2.84	$6.31
1913	2.54	6.03

This shows a decrease of 10.6 per cent in the cost per ton of capacity and 4.4 per cent per ton of tare.

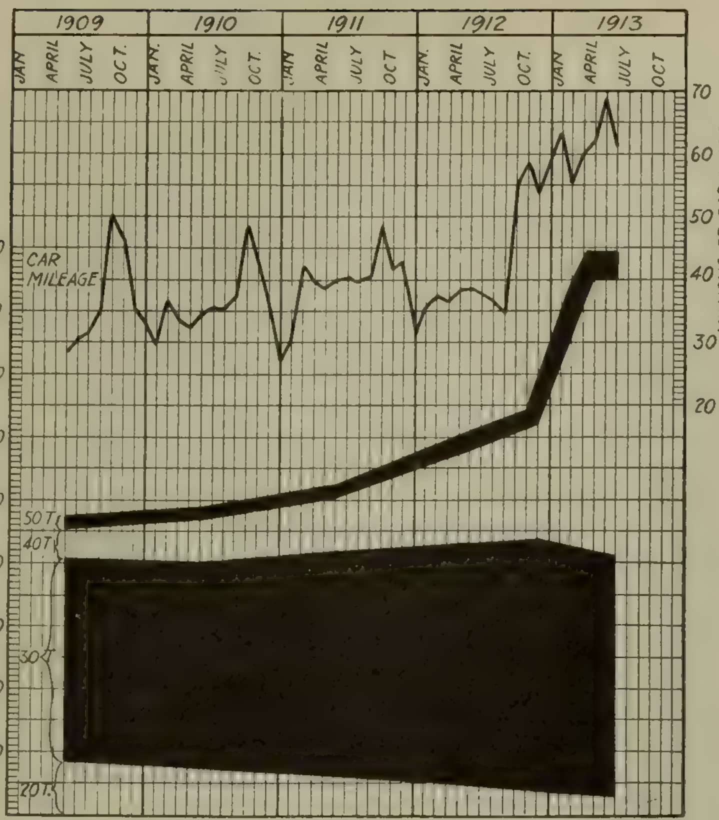


Fig. 1.

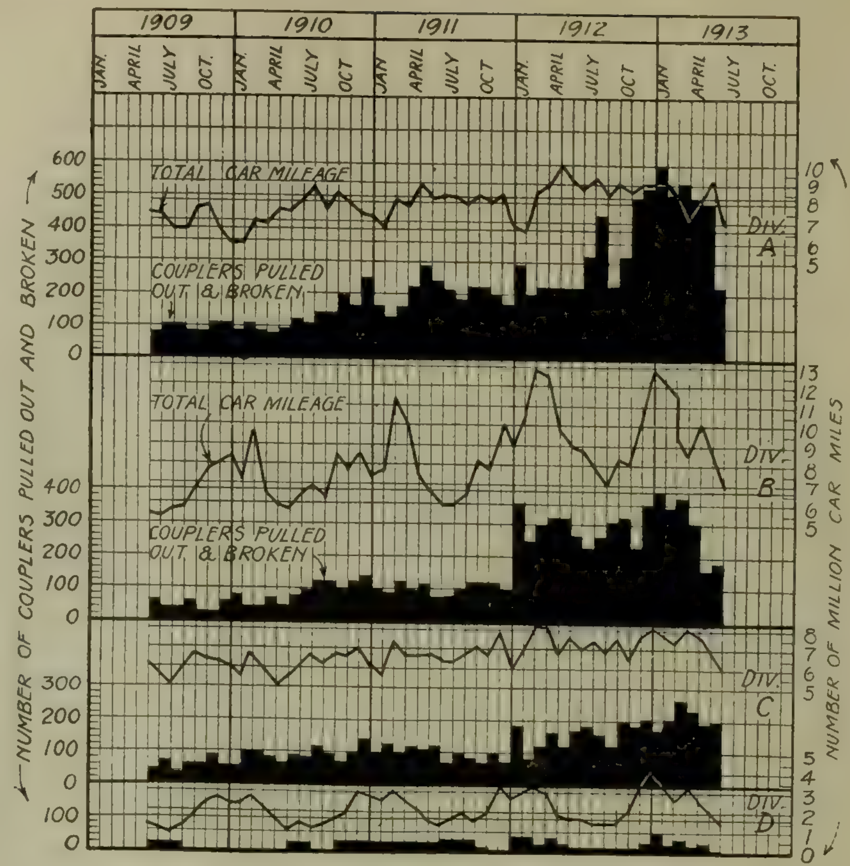


Fig. 2.

A fair basis for comparison would be on a gross ton mile basis, but the road had no data for 1904, and so the cost was compared for the 1907 period, which was the period during which the largest number of 25-ton cars and under were demolished. A comparison on this basis shows the cost in 1907 to be $22.86, as compared with $21.22 in 1913, showing a decrease in the cost of repairs and renewals on a gross ton mile basis of 7.22 per cent.

Basing judgment on the above figures, the mechanical head of this road concludes that the larger, heavier and more expensive freight car of the present time has greatly increased the aggregate cost for repairs, but that on any basis combining business handled and size of equipment that the cost per unit has decreased.

Interesting statistics with regard to freight car repairs are also given in the diagrams shown herewith. These are actual results from another large transcontinental system operating in a different territory from the one first mentioned. Figure 1 is a combination chart giving the number of revenue cars in service together with their mileage, the latter being represented by the upper line with its succession of jagged peaks. The lower portion showing the number of thousands of revenue cars is a cumulative chart. The lower edge of the large black space indicates the number of 20 ton cars in service at any time, while the upper edge of this space indicates the number of both 20- and 30-ton cars. Therefore the vertical distance between these lines at any point measures the number of 30-ton cars in service at that time. The number of 40- and 50-ton cars are shown in the same manner. Thus on July first, 1913, there were in service 3,000 twenty-ton cars, 38,000 thirty-ton cars, 44,000 forty-ton cars and 4,500 fifty-ton cars making a total of 89,500 cars of all classes.

The road has no 50,000 pounds capacity cars. It will be noted that the 20-ton cars have been steadily retired for the past four

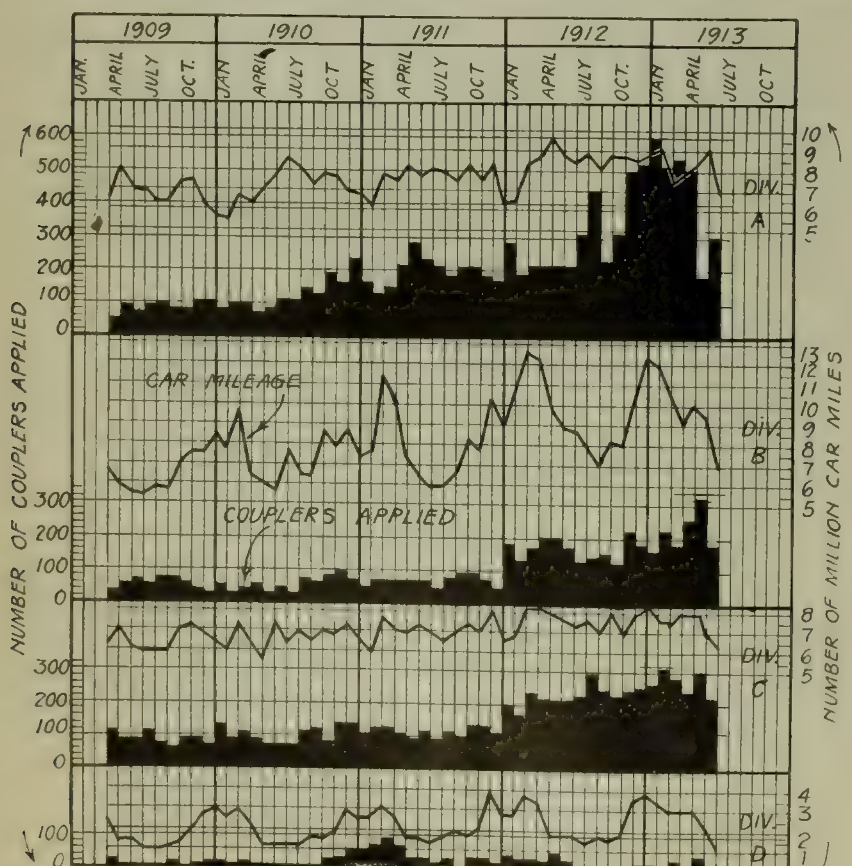


Fig. 3.

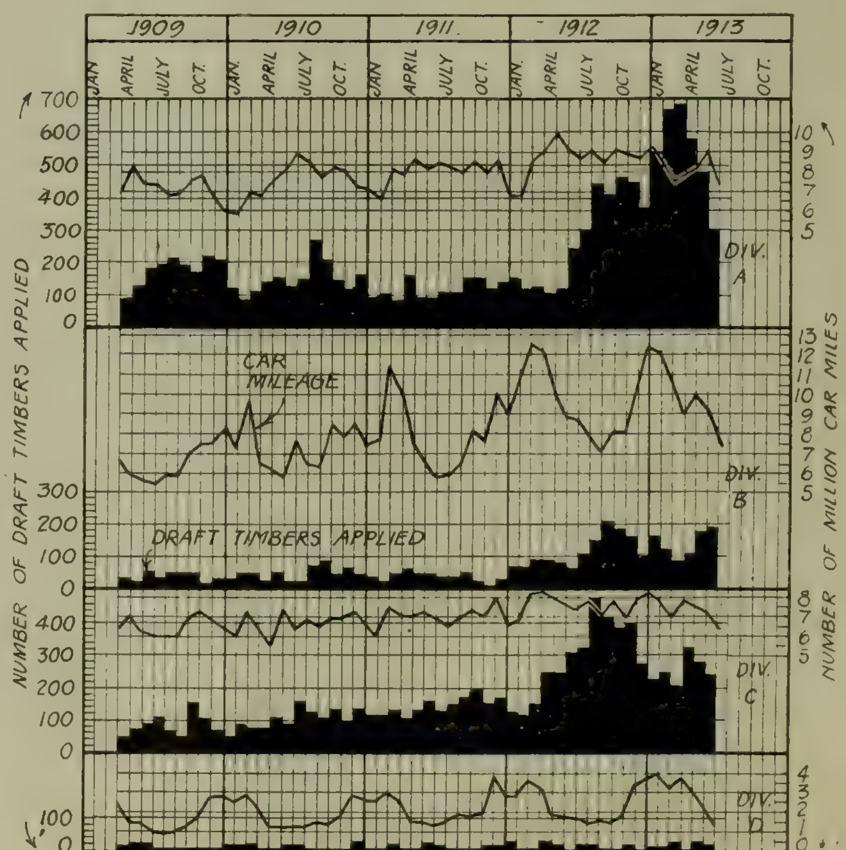


Fig. 4.

and a half years and that at the present rate they will all be retired in about a year and a half. The chart also shows a slight decrease in the number of 30-ton cars since the first of this year, while the most marked increase has been in the number of 40-ton cars.

Figure 2 shows graphically the number of couplers pulled out and broken on the various divisions of this road and also gives the car mileage. It includes both home and foreign cars and means broken couplers or anything which allowed couplers to pull out, such as broken rivets and pockets, split sills and split draft timbers. It will be noticed that on one of the divisions 600 couplers were pulled out in January, 1913, and that the number pulled out in 1912 and 1913 is startlingly high, there being about five times the amount of damage done in this way as was done in 1909. The larger percentage of the trouble was caused by split sills and broken bolts, practically all of which occurred on cars that were built previous to 1909.

These cars were in just as good shape as ever but could not stand the heavy service. After looking at this diagram it is interesting to know that this road now purchases very few more couplers than in 1909.

Figure 3 shows the couplers applied on the various divisions. Most of these couplers were reapplied because of pockets having been broken and rivets broken or pulled out on account of split sills. The car mileage is also given in this figure.

Figure 4 gives a record of draft timbers applied which bears out the information given in the other charts. The charts are made up from entirely different sources, one from material used and the other from inspectors' reports of failures.

On a basis of the statistics shown in figure 1 the percentage of cars of various capacities owned by this company in 1909 and in 1913 are as follows:

Capacity	1909	1913
20 tons	17.9%	3.3%
30 tons	67.4%	42.5%
40 and 50 tons	14.7%	54.2%

The growth in the percentage of 40- and 50-ton cars is marked but nevertheless this record has a larger percentage of light capacity cars in service that the road mentioned in the first cars are of 30-tons capacity and only .74 of one per cent are of 25 tons or less.

It will be noted in figure 2 that the heavy increase in pulled out and broken couplers begins at about the time when figure 1 shows a decided increase in the number of large capacity cars in service. A larger number of heavier cars in service of course means heavier trains and heavier power. With light capacity cars in service under conditions which they had not been designed to meet, it is not surprising that this increase in damage to them has occurred. The placing of a few of these smaller cars in a train of heavy cars, subjects their coupler and draft appliances to strains many times greater than those encountered when these cars were built. The car department of this road is therefore in favor of the retirement of light capacity box cars from interchange and the statistics as shown in the charts clearly uphold this point of view.

APPRENTICE EFFICIENCY.

By John Hewitt.

At the present day we cannot but notice the growing scarcity of good mechanics, and also, that in the present age, with all its invention and systems, there does not seem to be much more system in the training of apprentices than when I was a boy.

The technical colleges are turning out a great many students, but as a general rule, they do not seem to find the connecting link between theory and practice.

In a great many cases, were the average apprentice with his grammar school education given the same show that these boys are, he would go far ahead of them, in every day shop work. work.

I have studied the apprentice system in both contract and railroad shops and the same systems seem to prevail in both. As a general rule, he is turned loose to put in four years in different departments, and at the end of that time, he is turned out as a mechanic, but is he one?

If he is bright and of a studious nature, he will develop into a thinking man and will come out of his apprenticeship fairly equipped to hold his own with the journeyman, but if of a drifting nature and with no one to start him thinking, so much against him.

The question comes who is really the greatest looser? True, the boy is not what he should be, but taken from the money end, I believe the company who hires him is the greatest looser.

You will naturally say, "I do not have to hire an inefficient man." All well and good, but what are you going to do when they are all about the same standard?

Through lack of systematic training, you have turned out inefficient mechanics, they in turn go to a shop where the same lack of system is in vogue, and that shop's men come to you.

I do not know a place where a small outlay would bring such results as in the proper training of apprentices. I believe railroad shops suffer more than other shops, on account of the roving disposition of their mechanics.

The making of a railroad mechanic is different from the making of any other class of workman. He is a peculiar proposition.

It is an easy matter to use a specialist in a large shop, but in roundhouses or small shops he is of no use and it is into this class that a great many of the inefficient mechanics go. Taking all these conditions into consideration, you can not help but form your own solution of the problem.

First, I would suggest that you take the best all around man you have and make him the apprentice instructor. He should have the faculty of teaching and at the same time the faculty of a master.

There should be a course of study laid out, comprising a study of the whole locomotive, that would explain every part and its relation to other parts also its needs and uses. The apprentice should be called upon to make out a labor slip, that should go to instructor, naming the kind of work and time spent on it, each day. I would suggest an examination each month and the credit or demerits marked on all work he had performed.

Great care should be taken in choosing boys for apprenticeships, and at the beginning I should make it thoroughly understood that at least two nights per week should be devoted to study at some evening school or study class conducted by the company.

The reasons for the labor slips are these: It would give the instructor definite knowledge as to the boy's work. Many a boy does not get the chance he should have, and it is hardly to be expected that a boy, with a boy's mind, will put himself out to be interested in the concern that don't seem to have any interest in him.

A boy learns most of his trade from the man he is put to work with, and whether or not the man will instruct him or use him for a helper to a large extent determines how much he will learn. The instructor should be the man in this case to tell the boy the whys and wherefores.

In conclusion, I would like to see a system brought about, whereby an apprentice would serve his time, not by the number of days altogether, but in passing by a certain number of merit marks from year to year, until his apprenticeship was ended. There is no reason why a boy in his fourth year should not be more valuable than seventy-five per cent of the mechanics of today.

FUEL TESTS, CANADIAN NORTHERN RY.

At the request of the general manager, the mechanical department of the Canadian Northern Ry. recently made a comparative fuel test between class M-1-a engines, without superheaters, and class N-1-a engines, with superheaters. The tests were made on the Rainy River subdivision, which extends in a southeasterly direction from Winnipeg, and runs were made from Winnipeg to Rainy River, a distance of 153 miles. The tonnage rating over this division is as follows:

West M-1-a	West N-1-a		East M-1-a	East N-1-a
		Rainy River		
2000	2700		2400	3200
		Sprague		
1750	2450		1800	2400
		Woodridge		
1600	2250		Car Limit	Car Limit
		Winnipeg		

Both class M-1-a and class N-1-a engines were of the consolidation type burning bituminous coal, their general dimensions and specifications being as follows:

very lightly loaded than they do when loaded to a reasonable extent. All coal used, of course, was very carefully weighed.

The results of the tests are shown in the table. It will be noted that the results are all in favor of the larger class, N-1-a, engine equipped with superheater. Tests C and E were made under almost similar conditions eastbound, and tests B and F westbound. These are closely representative of the average performance of these engines with approximately full tonnage. In connection with eastbound tests C and E it will be seen that the superheater engine only burned 72.2 pounds of coal per 1,000 ton-miles, as against a consumption of 133.5 pounds per 1,000 ton-miles for the smaller engine. With westbound tests B and F the superheater engine burned 59.9 pounds, as against 110.4 of the smaller engine, the ratio remaining approximately the same in both directions, the difference in figures indicating the heavier grades encountered by the eastbound traffic.

At the time of the tests one of the oldest and best engineers said that with the class M-1-a engine he could always tell by the vibration when passing over bridges in the night, but that with the class N-1-a engine he frequently ran over culverts and short bridges in the dark without feeling them at all.

	M-1-a	N-1-a
Max. tract. effort	34,200 lbs.	45,000 lbs.
Type of boiler	Ext. wag. top	Ext. wag. top
Firebox	114⅛ in. x 41¾ in.	64¼ in. x 110⅞ in.
Number of tubes	300 2-in.	262 2-in., 26 5⅜ in.
Weight on front trucks	20,900 lbs.	40,000 lbs.
Weight on drivers	152,200 lbs.	190,000 lbs.
Total weight of engine	173,100 lbs.	230,000 lbs.
Total weight, engine and tender	141,300 lbs.	145,500 lbs.
Wt., engine and tender, in W. O.	314,400 lbs.	375,500 lbs.
Light weight of tender	57,300 lbs.	61,500 lbs.
Water capacity of tender	6,000 gal.	6,000 gal.
Coal capacity	12 tons	12 tons
Firebox heating surface	172 sq. ft.	180 sq. ft.
Flue heating surface	2,128 sq. ft.	2,650 sq. ft.
Total heating surface	2,300 sq. ft.	2,830 sq. ft.
Length of tubes	14 ft. 0 in.	15 ft. 3 in.
Grate area	32.1 sq. ft.	49 sq. ft.
Boiler pressure	200 lbs.	180 lbs.
Factor of adhesion	4.45	4.2

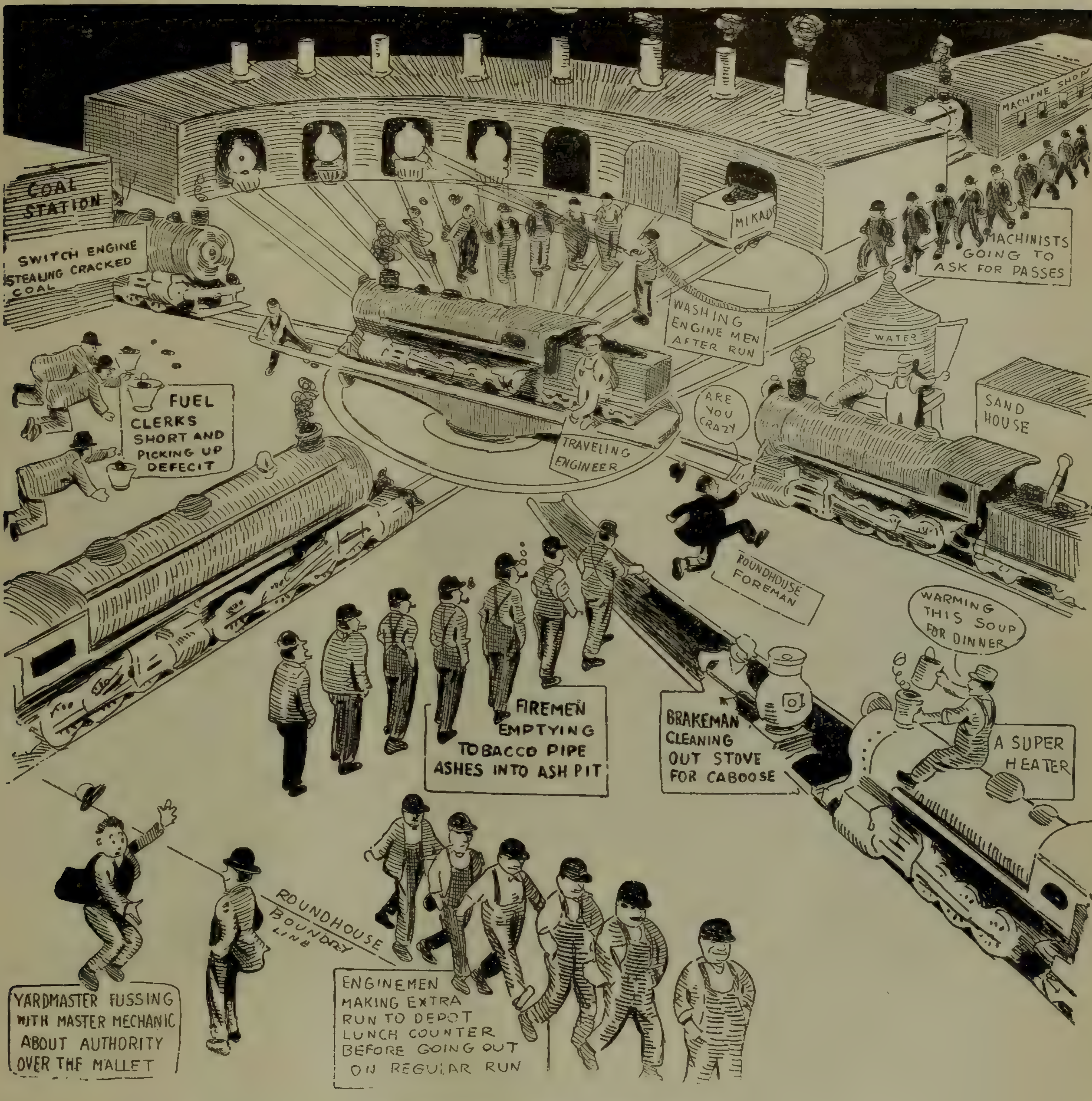
Test	Date	Engine	Direction	Tons Over Ruling Grade	Total Ton-Miles	Total Delays	Total Time Consumed	Actual Running Time	Lbs. Coal Consumed	Lbs. Coal per 1,000 Ton-Miles
A	Sept. 11th	2407	East	798	121,296	3:40	13:35	9:55	14,400	118.7
B	Sept. 13th	2407	West	2,275	345,800	2:45	13:35	10:50	20,600	59.9
C	Sept. 15th	2407	East	2,190	332,234	10:00	20:45	10:45	24,000	72.2
D	Sept. 16th	2407	West	1,901	286,951	2:35	12:15	9:40	14,400	50.00
E	Sept. 19th	2018	East	1,294	239,602	9:00	19:15	10:15	32,000	133.5
F	Sept. 21st	2018	West	1,800	273,600	2:50	13:15	10:25	30,200	110.4

The class M-1-a engine was built in 1907 by the Canadian Locomotive Co. and the class N-1-a about four years later by the Canadian Foundry Co. The class N-1-a engine was equipped with the Locomotive Superheater Co.'s type A top header superheater, and since the test the pressure on this engine has been increased to 200 pounds also.

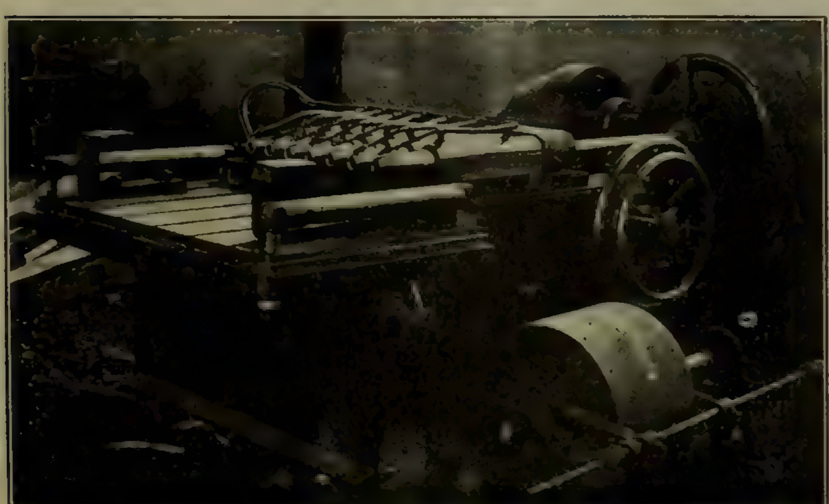
Six single trips were made, two with the M-1-a engine and four with the N-1-a engine. Both engines were handled by the same engine crew, with a road foreman in charge in each case. The ton mileage was arrived at by multiplying the total tonnage of the train, exclusive of the engine, by the mileage between reducing and picking-up points. No important factor was overlooked. Considerable trouble was experienced in obtaining tonnage, however, and it will be noted in the case of test "A" that the class N-1-a engine only had about one-third of a train and the relative fuel consumption was very high, clearly showing that engines burn relatively more fuel when

The conclusions reached by the test are that the class N-1-a superheater engines steam better, ride better, and curve much better than the class M-1-a engine, and that the larger engines are less injurious to the track in proportion to their weight.

For the first time in 15 years there is a decrease of 83.86 miles in main line mileage of railroads in Louisiana, due to the fact that the tap lines have been going out of business under a ruling made by the Interstate Commerce Commission that they are not common carriers, and therefore not entitled to a division of rates on through hauls. It is true that the commission was reversed by the United States Commerce Court, but so far has not led these roads to resume business. The total main-line mileage of the state at this time is 3,973.26, and spurs and branches, 1,283.79; which, with yard tracks, sidings, etc., gives a grand total of 6,860.04 miles of all tracks.



The Roundhouse as the Cartoonist Sees It.



Home-Made Horizontal Multi-Spindle Frog Drill.

HORIZONTAL MULTIPLE DRILL.

In the frog and switch shop of the Call Switch & Frog Company, of Denver, Colo., the method of drilling frogs was considered too slow and tedious an operation. As no machine adapted to the purpose was easily obtainable, a home-made machine which would drill all frog holes at one operation was designed by Ira Call, president of the company.

The machine is shown in the accompanying illustration. Seven horizontal spindles driven by a Morse chain operate simultaneously in drilling the bolt holes in the frogs which are clamped on the table in the assembled position. The use of the machine has reduced the cost of frog manufacture in this plant very considerably and the simplicity of the design is such as to make the machine an economical adjunct to any shop having frog work as a part of its output.

CARS FOR THE GRAND TRUNK.

The Grand Trunk Railway System has added to its car equipment recently a large number of steel cars of improved designs, comprising several thousand all steel hopper cars, 2,000 steel frame box cars and 250 steel underframe automobile cars, a brief description of which will no doubt be of interest at this time as an illustration of the fact that this road is providing equipment to properly take care of its traffic.

Hopper Cars.

These cars are specially adapted to the transportation of coal and coke, being self-cleaning and having doors which are easily and quickly opened or closed by means of a device which is positive in action as well as safe against accidental discharge of lading. An illustration of the car is shown herewith. They were built by the Pressed Steel Car Company, are designed to carry 100,000 pounds of coal with an addition of the usual 10 per cent overload, and have been giving excellent service.

Pressed shapes, plates and structural material have been used to the best advantage to obtain as light a car as possible, consistent with good practice, for the service required. The center sills, which extend from end sill to end sill, are made of 10-inch 20-pound channels, reinforced at top with cover plates, and at bottom with 3½ by 3½-inch angles. The side sills extend from bolster to end and are made of pressed steel 10 inches deep. Ten-inch 15-pound channels are used for end sills and are attached to side sills by means of gussets and malleable iron push pockets. The body bolster consists of a ¼-inch web plate, reinforced at top with a bent plate, and at bottom with 3½ by 3-inch angles, and an 18 by ⅜-inch tie plate, the center plate and brace being made of malleable iron.

The corners of car are further stiffened by means of diagonal braces made of 5 by 3-inch angles extending from body bolster at center to end sills at corner of car. The side, end and floor sheets are made of ¼-inch plates reinforced with flanges and angles, the sides being stiffened vertically by seven pressed steel stakes per side, two inside gussets at cross ridge and two channel braces extending across car near the top from side sheet to side sheet.

There are four doors, hung in pairs, each two doors being connected by two 5-inch channels, placed back to back, to which the operating arm of the door gear is connected. The operating device, which is known as the "Lind Gear," consists of levers and cams, is positive in action and when in the closed position the doors cannot be accidentally opened and lading discharged along the tracks.

The trucks are of the arch bar type with rolled channel top arch bar, 5 feet 6 inches wheel base, 5½ by 10-inch journals; pressed steel truck bolster and brake beams; malleable iron journal boxes and gray iron wheels being used.

All safety appliances are in accordance with the requirements of the Interstate Commerce Commission and the Canadian Railway Commission, in order to permit use of cars in service between United States and Canada.

The general dimensions of cars are as follows:

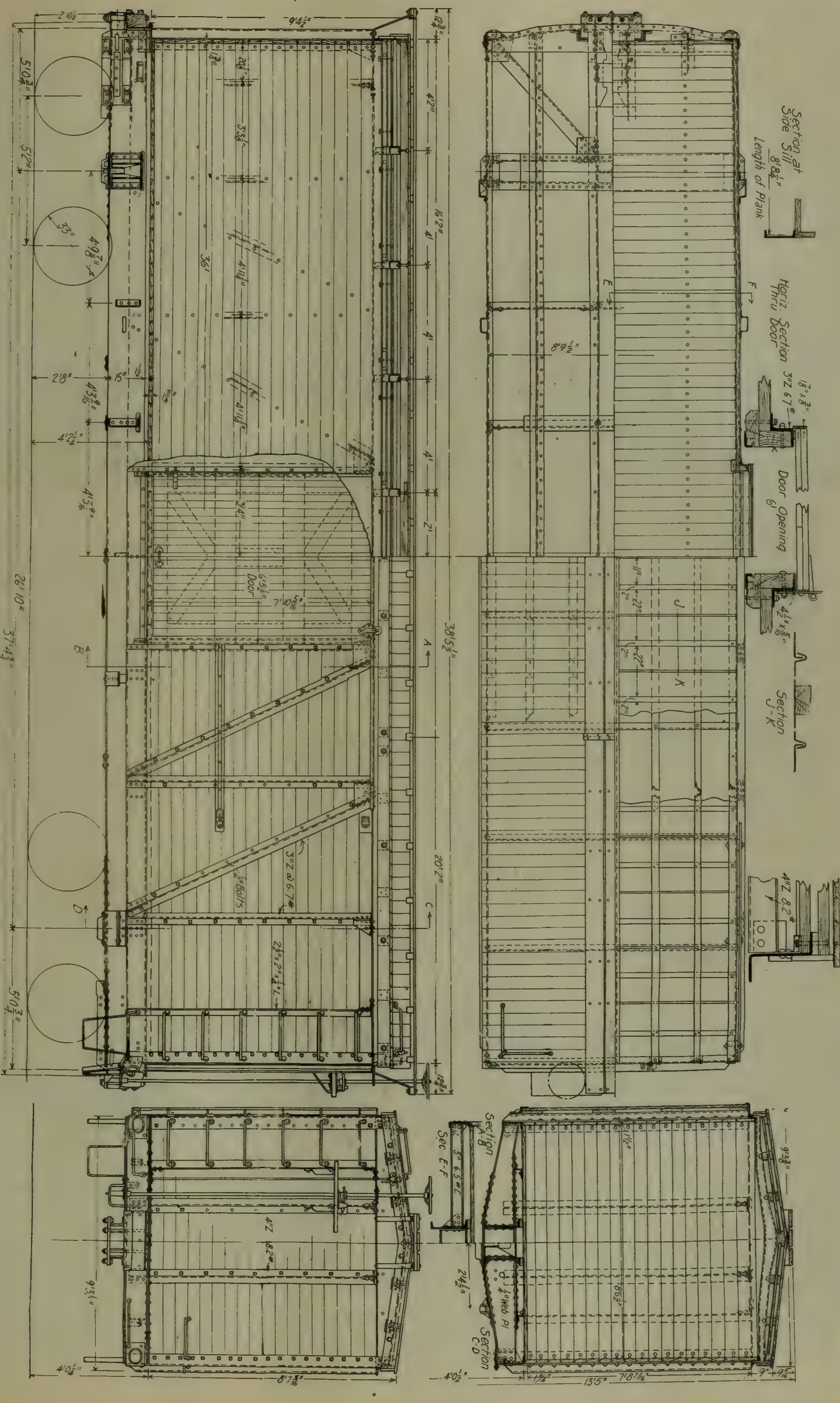
Length inside of body	30′ 0″
Width inside of body	9′ 6″
Width over side stakes	10′ 1½″
Length over end sills	31′ 6″
Height from rail to top of body	10′ 0″
Height from rail to top of brake mast	10′ 9″
Length of drop doors in clear	2′ 4¾″
Width of drop doors in clear	3′ 4½″
Weight of car body	20,600 lbs.
Weight of two trucks	16,400 lbs.
Light weight of car	37,000 lbs.
Percentage of paying load to total weight of car and lading	75%

Steel Frame 40 Foot Box Car, Grand Trunk Ry.

Two thousand steel frame box cars of 60,000 pounds capacity were recently completed at the McKees Rocks works of the Pressed Steel Car Company, and are shown in the illustration. These cars have steel under and upperframes and carlines, with wooden floor, roof and sheathing.

The center sills are 15-inch 33-pound channels and the side sills 8-inch 11¼-pound channels, all extending from end sill to end sill. The end sills are 10-inch 15-pound channels connected to side sills by means of gusset plates and pressed steel push pockets.

The body bolsters are built integral with underframe and are made of four pressed steel diaphragms and one cast center brace each, reinforced at top and bottom with 15 by ⅜-inch



General Arrangement of 60,000 Pounds Capacity Box Car for the Grand Trunk.

Automobile Car, Grand Trunk Ry.

cover plates. The underframe is further strengthened, transversely, by two cross bearers, made of pressed steel diaphragms, with top and bottom cover plates, 13 inches deep at center sills and 7 inches deep at side sills. Also by three shallow diaphragms made of 5 by 6½-inch channels. The side posts and braces are made of 3-inch 6.7-pound Z bars and the end posts of 4-inch 8.2-pound Zs, securely riveted to the side and end sills and plates.

The floor boards are made of yellow pine 1¾ inches thick, resting directly on side sills and bolted to intermediate Z bar stringers, being supported at center by yellow pine stringers resting on top of center sills. The side sheathing, or lining, is made of yellow pine 1½ inches thick, bolted to Z bar posts and braces with ½-inch bolts; the end lining being made of 1¾-inch yellow pine bolted to end and corner posts. There are two center side doors, one on each side of car made of yellow pine.

Cars are equipped with Westinghouse air brakes, cast steel couplers, vertical twin spring draft gear with key attachment to couplers, roller side bearings, inside metal roof and all safety appliances in accordance with the Interstate Commerce Commission requirements.

The trucks are of the arch bar type with 4¼ by 8-inch journals and 5 feet 2-inch base, equipped with pressed steel bolsters, cast steel center plates, M. C. B. brake beams, steel back shoes, malleable iron boxes and 625-pound gray iron wheels.

The general dimensions of car are as follows:

Length inside of car	36′ 0″
Width inside of car	8′ 6½″
Height from floor to carlines	8′ 0½″
Width of door opening	6′ 0″
Height of door opening	7′ 7¾″
Length over end sills	37′ 4¾″
Width over side sills	8′ 9½″
Width over eaves	9′ 3⅜″

Hopper Car, Grand Trunk System.

Height from rail to top of floor	4′ 2¼″
Height from rail to roof at eaves	12′ 7¾″
Height from rail to top of running boards	13′ 5″
Height from rail to top of brake mast	13′ 11¼″
Weight of car body	23,000 lbs.
Weight of two trucks	12,300 lbs.
Total light weight of car	35,300 lbs.

Automobile Cars.

The 60,000 pounds capacity automobile cars which were built for this company by the Western Steel Car & Foundry Company at its Hegewisch, Ill., plant, are also illustrated herewith and are of the following dimensions:

Length over striking plate	41′ 8″
Length over running boards	42′ 0⅛″
Length inside	40′ 0″
Height from floor to carline	8′ 6″
Height from top of rail to top of floor	3′ 8″
Height from top of rail to eaves	12′ 8 3/16″
Height from top of rail to top of running board	13′ 6″
Height from top of rail to top of brake mast	14′ 0″
Height of side door opening in clear	8′ 1¾″
Width of side door opening	9′ 0″
Width inside of body	8′ 6⅛″
Width over eaves	9′ 6″
Width over side sills	9′ 0¾″
Center to center of truck	30′ 6″
Height of end door opening in clear	8′ 1¾″
Width of end door opening in clear	7′ 9¾″

The steel underframe of these cars is principally of the structural type composed of plates and shapes, except for the bolster and cross bearer diaphragms, which are pressed steel. The superstructure is of a wooden type with diagonal tie rods in the side, and each side is fitted with double side doors set off center. One end is fitted with double hinged end doors with a vertical operated locking device. The roof is of the inside metal type and the car is braced longitudinally by diagonal braces fitted into the side plates and carlines.

One thousand gondola cars are now being turned out by the Pressed Steel Car Company for the Grand Trunk Railway System and an additional order of 3,000 box cars is soon to be turned out by the Western Steel Car & Foundry Company.

WHO DID THIS?

When the boss swings through the office like a tornado, rip-snorting among the desks—looking for the fellow who made the mistake—you begin to shrink inside; your hat slips down over your ears and you can turn around in your suit without taking it off. It does make a fellow feel uneasy around the nerve centers when he did slip a cog and the boss is storming along the line, looking for some unlucky cuss upon whom he can vent his spleen.

Takes a big man to "fess up" at a time like that. You've got to have a pile of courage to face the raving monster—but it's got to be done. A little lie might save you—but the big man will stick to his principles if it costs him his job. He'll "fess up."

Be true to your better instincts. Who's afraid of losing a job that can be lost by being manly—courageous—honest and clean. Better be out of that kind of a job than in it. A job like that is a wet blanket on your finer sentiments—your worth.

At any rate—don't let fear drive you to deception at the expense of the better qualities within you. Speak out—say it strong. I DID IT. I AM SORRY. IT WAS MY FAULT.—*Exchange.*

COMPARATIVE PROFILES of the western lines of eight trans-continental lines show that the Cadanian Northern has a maximum grade of .7 per cent with a maximum elevation of 3,706 feet. The Grand Trunk Pacific comes next with a maximum grade of 1.0 per cent and a maximum elevation of 3,719 feet. The Santa Fe has the steepest grade, it being 2.6 per cent.

CENTRALIZED CONTROL SYSTEM FOR PANAMA CANAL LOCKS.

The electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouses a lively interest but also presents an opportunity for much valuable instruction. The interest results mainly from the size of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the Isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission,

EDWARD SCHILDHAUER,
Elect. and Mech. Engineer, Isthmian Canal Commission.

assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problems, and Mr. W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

Generation and Distribution.

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control, is composed of:

A 7,500 kv-a, 2,200 volt hydroelectric power plant at the Gatun Dam;

A 4,500 kv-a 2,200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the Isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000-2,200 volt substations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2,200-240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2,200-220-110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000-2,200 volt substations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls, the oil switches are hand operated. All 2,200 volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

For the hand operated switches, a pipe framework supports vertical metal guides which carry the oil switch operating mechanism and slate base forming a section of the switchboard panel. On the guides a lever and toggle mechanism is mounted, by which the oil switch and slate base may be raised and lowered. Above the oil switch and mounted on the pipe framework a stationary cast iron base carries the disconnecting switch studs and insulators. The high tension leads run to the tops of the disconnecting switch studs, and the bottom of each stud is equipped with contact fingers. On the top of each oil switch stud is mounted a contact blade. When the oil switch is raised, these blades engage the contacts on the bottom of the disconnecting switch studs, which thus in the closed position form extensions of the oil switch studs. The disconnecting switch contacts are surrounded by insulating shields which prevent accidental contact. When the oil switch is lowered, it is completely isolated from the circuit. When the oil switch is raised, it always goes to a fixed height where it is latched. An interlock prevents the oil switch from being raised or lowered unless its contacts are open, precluding the circuit being closed or opened by the disconnecting switch. In some instances another interlock makes two single-throw switches a double-throw switch and prevents both switches being closed at the same time.

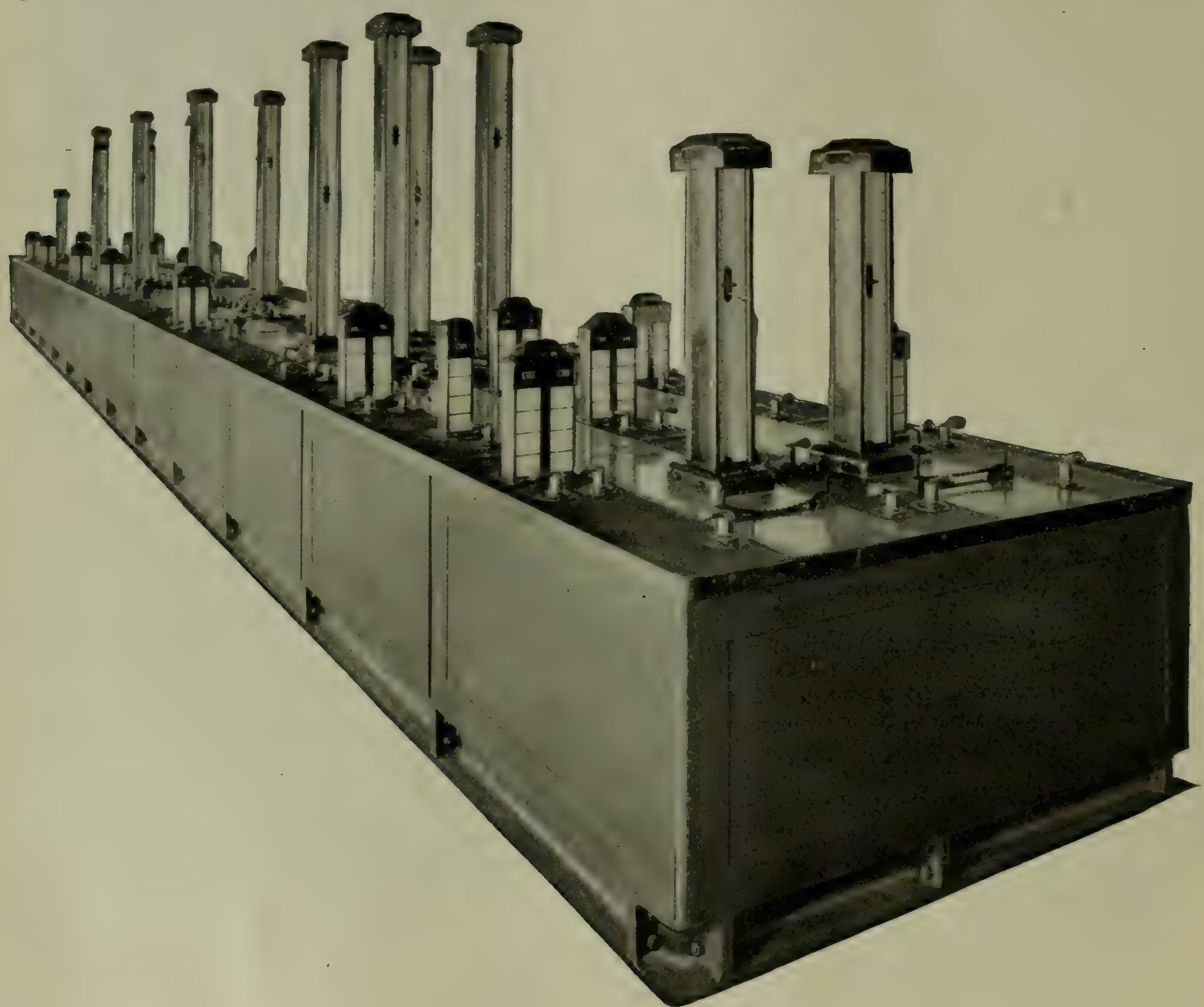
For solenoid operated switches, the same form of disconnecting switch is used; but the solenoid is stationary and the connecting mechanism to the oil switch has a vertical slotted link which allows the oil switch to be raised and lowered without being disconnected from the solenoid mechanism. A mechanical interlock prevents the raising or lowering of an oil switch while in the closed position.

The instrument and control board for the Gatun generating station is of natural black slate, as are all the switchboards for the power system. It is totally enclosed by means of grille work with doors at each end. The switchboards for the transmission line substations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grille work with doors at each end.

Power Supply and Control Panels for Lock Machinery Motors.

Current for the lock machinery and towing locomotives is transformed from the 2,200 volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate 200 kv-a. 3-phase 2,200-240 volt transformers for power and one single-phase 25 kv-a. 2,200-220-110 volt transformer for lighting. The stations, normally fed from the 2,200 volt buses in the 44,000-2,200 volt substations, can also be operated from the power plants; the stations at Gatun locks from the Gatun hydro-electric station; and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

The motors are started and controlled by contactor panels located near them, the contactors of which handle the main motor currents. These contactors are controlled from the central control



Centralized Control Board for Miraflores Lock.

Control House at Gatun.

house. The smaller motors, including those for cylindrical valves, auxiliary culvert valves and miter forcing, are started by being thrown directly on the line. Two double-pole contactors are used, one for forward and one for reverse. In the case of larger motors for miter gate moving, rising stem valves and guard valves, a starting point with resistance in two legs of the three-phase circuit is provided.

In all cases the contactors are operated from the control boards by three wires, one for forward, one for reverse and a common return. In the case of panels having a starting point, the period during which the motor remains on the resistance is automatically controlled by a dashpot, so that the starting operation at the control house is the same, simply energizing a forward or reverse wire as the case may be. The control connections are arranged in such manner that each individual machine may be controlled locally. This arrangement provides for emergency operation should the control circuits from the central control house be out of order.

Location and Operation of Lock Machinery.

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine.

On the top of all mitering gates a foot walk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails are therefore made to be raised and lowered. This is done by a motor under the foot walk, controlled from the lock wall. Near the approach to each foot walk a controller is located in the lock wall flush with the surface, this controller being operated by a foot push. If the gates are closed and the hand rails are down, and it is desired to cross on the gates, the foot push is pressed and the hand rails are raised by their motors. This is true not only of the hand rails on the nearer gate leaf, but of the hand rails on the farther leaf as well. After passing across, one can, if one desires, press the foot push on the other side and both hand rails will be lowered. Or, if one leaves the hand rails up and the gates are opened by the operator in the control house, they will be automatically lowered so as to be out of the way when the gate is in the recess. When the gates are again closed, the hand rails will automatically rise again if the foot controller has been operated in the mean time. The hand rails cannot be raised when the gates are opened, and no harm results if the foot switch is operated while the gates are in the closed position.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers, and up through openings in the lock floors.

The rising stem valves are installed in pairs, and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and makes it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. They perform service exactly similar to the rising stem valves, except that three valves in parallel in this case must conform to the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

Centralized Control and Indicating System.

The control boards are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

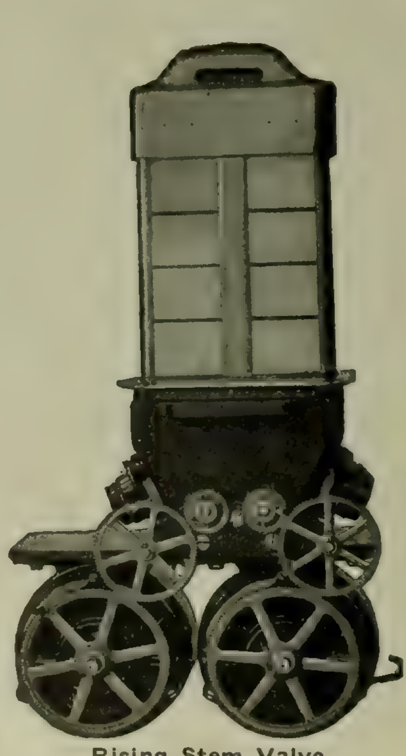
For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate, according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point.

A complete synchronous indicator consists of a transmitter located at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have three-phase windings with leads from three corresponding equidistant points brougt out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110-volt, 25-cycle, single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the three-phase connection above mentioned to the receiver stator coils and duplicates in them but in the reverse direction, the same conditions of polarity and voltage as present in the transmitter. The rotor of the receiver being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the position indicator a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows.

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft, and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board, where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.


Water Level Indicator.


Rising Stem Valve Indicator.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate. Both front and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. A small aluminum cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the portion above is dark.

Water Level Indicators.

The specifications covering the water level indication required an accuracy of 1-20 of a foot, or 1-10 of 1 per cent in actual water level. In the transmitters and receivers for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than one-half revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 degrees.

The fine index is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminum ball representing the coarse index, which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct within the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping phosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

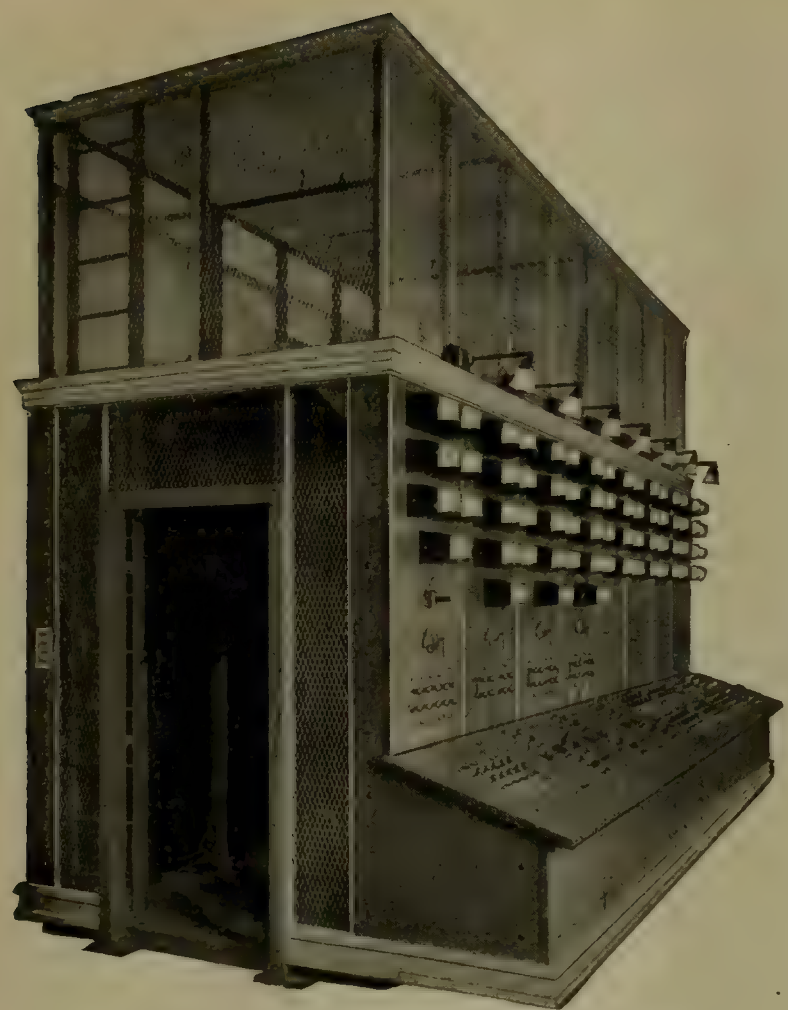
The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine.

Control Boards Represent Locks in Miniature.

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.



2200-Volt A. C. Instrument and Control Board.

Special Climatic Requirements.

To withstand the humid atmosphere of the Isthmus, every insulated part, such as solenoid, relay, circuit breaker and other coils, was impregnated with non-hygroscopic compounds. All small parts were made either of brass, copper, Monel metal, bronze, or of sherardized iron or steel. Mica and treated asbestos lumber were used largely in place of fiber or wood.

Interesting Manufacturing Details.

Nearly two thousand special drawings were required in their fabrication, and there were also involved the following unusual quantities of materials:

Special slate bases	1,300
Small castings	160,000
Screw machine parts	1,200,000
Copper rod and bar	58,000 ft.
Asbestos lumber	9,000 sq. ft.
New patterns	650
New jigs, templates, tools, etc.	625
Porcelain parts	18,000
Special bus supports	6,800
Gal. pipe (framework)	21,000 ft.
Special gears	2,300
Special instruments	640
Miscellaneous sherardized pieces	300,000
Cases for boxing	4,150

The combined weight of the centralized control boards for Gatun, Pedro Miguel and Miraflores is about thirty-nine tons. In their construction there is employed—

More than 2¼ miles of interlocking rod.

About six million feet of control leads—made up in five and eight-conductor cables.

Seven hundred and thirty-two motors.

Four hundred and sixty-four switches.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line substation equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.

Personals

E. C. LaCoss succeeds C. L. Perrin as foreman of the *Atchison, Topeka & Santa Fe* at Vaughn, N. M.

E. T. Mullen succeeds Charles Johnson as foreman of the *Atchison, Topeka & Santa Fe* at Seligman, Ariz.

A. J. Cunningham has been appointed foreman of the *Atchison, Topeka & Santa Fe* at Barstow, Cal., succeeding C. D. Mack.

F. W. Boardman succeeds W. Sennott as master mechanic of the *Baltimore & Ohio* at Eastside, Philadelphia, Pa.

M. T. Nash has been appointed general locomotive foreman of the *Baltimore & Ohio* at Holloway, O. He succeeds H. Ainscough.

G. A. Schaiffn succeeds J. J. Foley as general locomotive foreman of the *Baltimore & Ohio* at Weston, W. Va.

E. E. Hoover succeeds J. A. McGuire as general locomotive foreman of the *Baltimore & Ohio* at Holloway, O.

E. J. Creel has been appointed general locomotive foreman of the *Baltimore & Ohio* at Painesville, O.

F. T. Summers succeeds J. H. Agar as general car foreman of the *Baltimore & Ohio* at Garrett, Ind.

J. D. Beltz has been promoted to road foreman of engines of the *Baltimore & Ohio* with office at Pittsburgh, Pa.

G. N. Gage has been appointed assistant road foreman of engines of the *Baltimore & Ohio* with headquarters at Rockwood, Pa.

F. S. Deveny has been appointed road foreman of engines of the *Baltimore & Ohio* with office at Chicago Junction, O.

J. C. Basford has been appointed road foreman of engines of the *Baltimore & Ohio* with office at Philadelphia, Pa.

J. P. Haran has been appointed general foreman of the *Baltimore & Ohio South Western* with office at East St. Louis, Ill. He succeeds J. F. Kane.

J. W. Neill succeeds J. P. McAnany as master mechanic of the *Canadian Pacific* with office at Moose Jaw, Sask.

George Logan has been appointed general foreman of the *Chicago & North Western* at Clinton, Ia., succeeding C. D. Ashmore.

W. H. Halsey succeeds George Logan as general foreman of the *Chicago & North Western* at Missouri Valley, Ia.

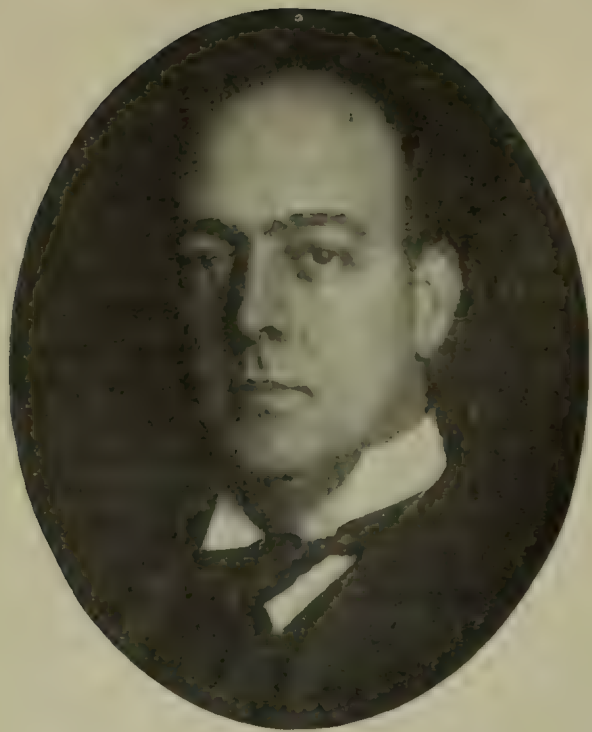
L. Chapman succeeds W. H. Halsey as shop foreman of the *Chicago & North Western* at Chadron, Neb.

John J. Murphy succeeds L. Chapman as shop foreman of the *Chicago & North Western* at Norfolk, Neb.

Herman Witte has been appointed shop foreman of the *Chicago & North Western* at Fremont, Neb. He succeeds John J. Murphy.

C. R. Fryant has been appointed shop foreman of the *Chicago & North Western* at Wyeville, Wis., succeeding G. Schimming.

Frederick A. Delano has been elected president of the *Chicago, Indianapolis & Louisville,* to succeed Fairfax Harrison, recently elected president of the Southern. Mr. Delano was born at Hong Kong, China, September 10, 1863, graduated from Harvard University and began his railway career in 1885 as machinist apprentice in the shops of the Chicago, Burlington & Quincy, at Aurora, Ill. For two years he was in charge of the bureau of steel rail inspection tests and records; from April, 1889, to July, 1890, assistant to the second vice-president of the same road, and from July, 1890, to January 31, 1899, superintendent of freight terminals at Chicago. He was superintendent of motive power of the Chicago, Burlington & Quincy from February 1, 1899, to July 1, 1901, and general manager from July, 1901, to January 10, 1905. In March, 1905, he became consulting engineer to the War Department and the Philippine Commission and was elected first vice-president of the Wabash on May 1, 1905. In October, of the same year he was chosen president. He was also president of the Wheeling & Lake Erie R. R. from May 1, 1905, to 1908 and since May, 1905, has been



F. A. Delano.

president of the Wabash-Pittsburg Terminal Ry. He has been a receiver of the Wabash Railroad since December, 1911, until his present appointment.

C. W. JONES has been appointed general manager of the first district of the *Chicago, Rock Island & Pacific* with office at Des Moines, Ia., succeeding W. M. Whitenton, resigned.

F. J. EASLEY has been appointed assistant general manager of the first district of the *Chicago, Rock Island & Pacific* with office at Des Moines, Ia. He succeeds T. H. Beacom, promoted.

T. H. BEACOM has been appointed assistant general manager of the third district of the *Chicago, Rock Island & Pacific* with office at El Reno, Okla. He succeeds C. W. Jones, transferred.

R. W. PRITCHARD has been appointed assistant superintendent car department of the *Chicago, Rock Island & Pacific* with office at Chicago.

R. C. HYDE, master mechanic of the *Chicago, Rock Island & Pacific*, has been transferred from El Dorado, Ark., to Manly, Ia., succeeding F. W. Williams, resigned.

W. J. EDDY has been appointed master mechanic of the *Chicago, Rock Island & Pacific*, at El Dorado, Ark., succeeding R. C. Hyde. Mr. Eddy was formerly inspector of tools and machinery at Chicago.

WILLIAM GARSTANG, general master car builder of the *Cleveland, Cincinnati, Chicago & St. Louis*, retired from railway service on the first of the year, after having served 50 years in the mechanical department. Mr. Garstang was born in England in 1851 and in 1862 did his first work in railroading by carrying water for the contractors on track laying work between Fort Erie and Niagara. In December 1863 he entered the mechanical department as a machinist apprentice on the Cleveland & Erie at Cleveland, O. He remained here six years, in the meanwhile attending night school. Following this period, he spent eleven years as machinist and general foreman of the Atlantic & Great Western and the New York, Pennsylvania & Ohio; three years as general foreman on the Pennsylvania and five years as master mechanic of the Cleveland, Columbus, Cincinnati & Indianapolis (now the Big Four). In 1888 he was appointed superintendent of motive power of the Chesapeake & Ohio and in 1893 accepted a similar position on the Big Four. A year ago his title was changed to general master car builder and he has since served largely in an advisory capacity. Mr. Garstang was president of the American Railway Master Mechanics' Association in 1894 and 1895 and has been connected with that association about thirty-five years. For the past twelve years he has been chairman of the Master Car Builders' committee on standard wheels.

William Garstang.

J. P. GRIFFIN, road foreman of engines of the *Chicago & Alton* at Slater, Mo., has resigned.

GEO. MCLEAN has been appointed car foreman of the *Chicago Great Western* at Oelwein, Ia., succeeding W. R. Lutem.

G. F. HENNESSEY has been appointed general car and locomotive foreman of the *Chicago, Milwaukee & St. Paul* at Marion, Ia.

FRANK R. JONES has been appointed foreman of locomotive repairs of the *Chicago, St. Paul, Minneapolis & Omaha* with office at Omaha, Neb.

F. I. PLECHNER has been appointed assistant purchasing agent of the *Great Northern* with office at St. Paul, Minn.

J. B. HASLET has been appointed locomotive foreman of the *Great Northern* at Breckenridge, Minn. He succeeds Wm. Krier.

J. P. COONEY has been appointed locomotive foreman of the *Great Northern* at Casselton, N. D., succeeding J. T. Murtinger.

OSCAR ANDERSON succeeds W. E. Johnston as car foreman of the *Great Northern* at Skykomish, Wash.

JOHN KRUTTSCHNITT has been appointed mechanical inspector of the *Illinois Central* with office at Chicago.

FRANK MCMANAMY has been appointed chief of the division of locomotive boiler inspection of the *Interstate Commerce Commission*, succeeding the late John F. Ensign.

WM. BAKER has been appointed road foreman of engines of the *Lehigh Valley* with office at Wilkes-Barre, Pa.

J. I. KEIPER succeeds John Roney as road foreman of engines of the *Lehigh Valley* at South Easton, Pa.

H. KUGLER has been appointed road foreman of engines of the *Lehigh Valley* at Buffalo, N. Y.

L. W. ENGLEHART succeeds B. F. Gram as traveling engineer of the *Minneapolis, St. Paul & Sault Ste. Marie* with office at Glenwood, Minn.

E. W. HARTOUGH has been appointed car foreman of the *Missouri, Kansas & Texas* with office at St. Louis, Mo.

C. B. RANDALL succeeds W. A. Curley as master mechanic of the *Missouri Pacific* at Van Buren, Ark.

W. A. CURLEY succeeds W. J. McKiernan as master mechanic of the *Missouri Pacific* with office at Monroe, La.

F. H. EDMONDS has been appointed traveling car inspector of the *Missouri Pacific* with office at Little Rock, Ark. He succeeds C. F. Mase.

C. F. MASE succeeds J. Bowman as general foreman car department of the *Missouri Pacific* with office at Argenta, Ark.

M. R. DUCEY succeeds D. E. Moodie as storekeeper of the *Mobile & Ohio* at Meridian, Miss.

JOHN H. PEYTON has been elected president of the *Nashville, Chattanooga & St. Louis*, succeeding the late John W. Thomas, Jr., effective April 1, 1914. Mr. Peyton is assistant to the president of the Louisville & Nashville.

W. F. OWEN has been appointed receiver of the *New Orleans, Mobile & Chicago* with office at Mobile, Ala. Mr. Owen was formerly president and general manager.

J. W. SASSER succeeds J. R. Gould as superintendent of motive power of the *Norfolk Southern* with office at Norfolk, Va.

M. S. MONTGOMERY has been appointed road foreman of engines of the *Northern Pacific* with office at Duluth, Minn.

W. V. WICKS has been appointed road foreman of engines of the *Northern Pacific* with office at Jamestown, N. D.

S. OLSON, general shop foreman of the *Oregon Short Line*, has been transferred from Ogden, Utah, to Pocatello, Ida.

J. E. STONE has been appointed general shop foreman of the *Oregon Short Line* at Ogden, Utah.

J. M. HENRY, as announced in our last issue, has been appointed superintendent of motive power of the western Pennsylvania division of the *Pennsylvania*. Mr. Henry was born in Altoona, Pa., October 10, 1873. He graduated from Purdue University, and started work for the Pennsylvania in 1889, as messenger. He worked as machinist in the Altoona machine shops during his vacations while at college, and after he graduated, in 1900, he went to work as machinist. He was made inspector in 1901 and in 1902 was made assistant engineer of motive power in the office of the superintendent of motive power on the old Philadelphia and Erie railroad. He was appointed master mechanic in 1903, and served in that capacity on the Elmira, Eastern, Williamsport, Buffalo and Philadelphia Terminal divisions. He was promoted to superintendent of motive power on December 1, 1913.

J. D. WALLEN has been appointed car shop foreman of the *Pennsylvania* at Oil City, Pa., succeeding J. F. Lichtenfels.

W. C. LINDER succeeds J. E. Ruff as car shop foreman of the *Pennsylvania* at Shire Oaks, Pa.

A. H. SHOUP has been appointed car shop foreman of the *Pennsylvania* at Cresson, Pa. He succeeds D. Hengstler.

J. J. DEITCHE has been appointed general foreman of the *Pere Marquette* at Chicago succeeding E. W. Hartough.

F. J. HARPER has been appointed traveling piece work inspector of *St. Louis & San Francisco* with headquarters at Springfield, Mo.

J. M. DAVIS, general superintendent of the *Southern Pacific* at San Francisco, has resigned, effective January 1. It is said that he will become general manager of an eastern road.

J. O'CONNOR has been appointed master mechanic of the *Staten Island Rapid Transit*, with headquarters at Clifton, N. Y. The position of assistant master mechanic has been abolished.

M. MERRYMAN has been appointed general storekeeper of the *Western Maryland*, with office at Hagerstown, Md.

OBITUARY.

A. B. PHILLIPS, general foreman of the *Denver & Rio Grande*, at Salt Lake City, Utah, died on December 6.

D. A. JONES, president of the *Mississippi River & Bonne Terre*, died on December 7 at St. Louis, Mo.

B. BOUTET, assistant interchange inspector at Cincinnati, died on November 15, 1913. He was a brother of Henry Boutet.

J. W. THOMAS, JR., president and general manager of the *Nashville, Chattanooga & St. Louis*, died on December 17, at Nashville, Tenn. He was 57 years of age. Death was due to pneumonia.

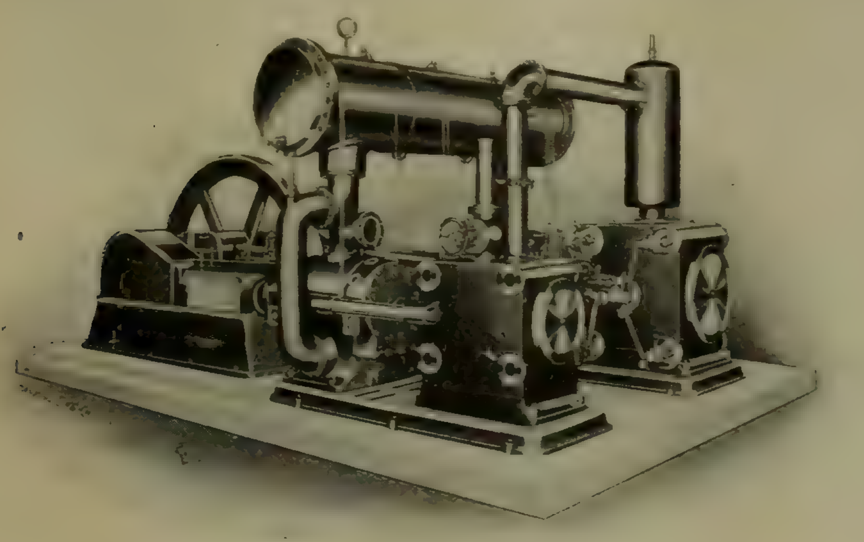
Among The Manufacturers

HEAVY CROSS-COMPOUND, TWO-STAGE AIR COMPRESSOR.

The Delaware, Lackawanna & Western has recently installed in its Kiser Valley shops at Staunton, Pa., a Chicago Pneumatic 2,500-foot, two-stage compressor, equipped with Corliss cross compound steam cylinders and designed for the highest steam economy and resulting minimum fuel consumption.

The illustration shows the compressor on the testing floor of the Franklin, Pa., shops of the Chicago Pneumatic Tool Co., it being the practice of the company to completely assemble and thoroughly test all machines previous to shipment.

This unit has steam cylinders 19 in. and 31 in. in diameter, respectively, for the H.P. and L.P., the L.P. air cylinder being 28 in. and the H.P. 17 in. in diameter, with a common stroke of 26 in., the free air displacement being 2,500 cu. ft. per minute at 135 R.P.M., which is the maximum speed for which the air and steam valves and parts are designed. Steam and exhaust valves are of the Corliss type, operated by a simple system of links connected to wrist plates, which in turn are driven from eccentrics on the crank shaft, the entire valve gearing of the machine being simplified as far as possible or practicable and operating quietly at the highest speeds.



Heavy Cross Compound Two-Stage Compressor.

Variable delivery of air to meet the demands is at all times provided for the application of a sensitive speed governor and air pressure regulator operating on the steam valve gear to momentarily change the point of cut off by a sufficient amount to allow the compressor to assume the speed to correspond to the air load. As this load is constant per stroke the M.E.P. and consequently the point of cut off at the steam end is practically constant regardless of the speed this gives an opportunity for the employment of compound cylinders exactly proportioned for the steam conditions, and permitting of economies far exceeding those of constant speed engines.

A minimum power consumption is obtained by a carefully designed air end, which, as shown in the illustration, includes a very large intercooler, through the employment of which air is delivered to the H.P. cylinder at very nearly the temperature of the atmosphere, this being the ideal condition in the economical compression of air.

Friction losses in this type of compressor are reduced to a minimum, due to the employment of large pins and bearings throughout, the maintenance of perfect alignment through the use of continuous sole plates beneath the cylinders, the exclusion of dust and dirt by the enclosed construction, and particularly to the unexcelled system of positive lubricating at all speeds.

THURMAN CAR CLEANER.

Although the vacuum cleaner has proved itself a valuable piece of apparatus in the home, it is a device which proves especially adaptable for the cleaning of railway coaches. The Thurman Vacuum Cleaner Co., St. Louis, Mo., has placed on the market a combined compressed air and vacuum method of cleaning which is an improvement on the straight vacuum method. When the car has reached the terminal yard, a hose from the yard air line is taken into the car and attached to the dust tank shown

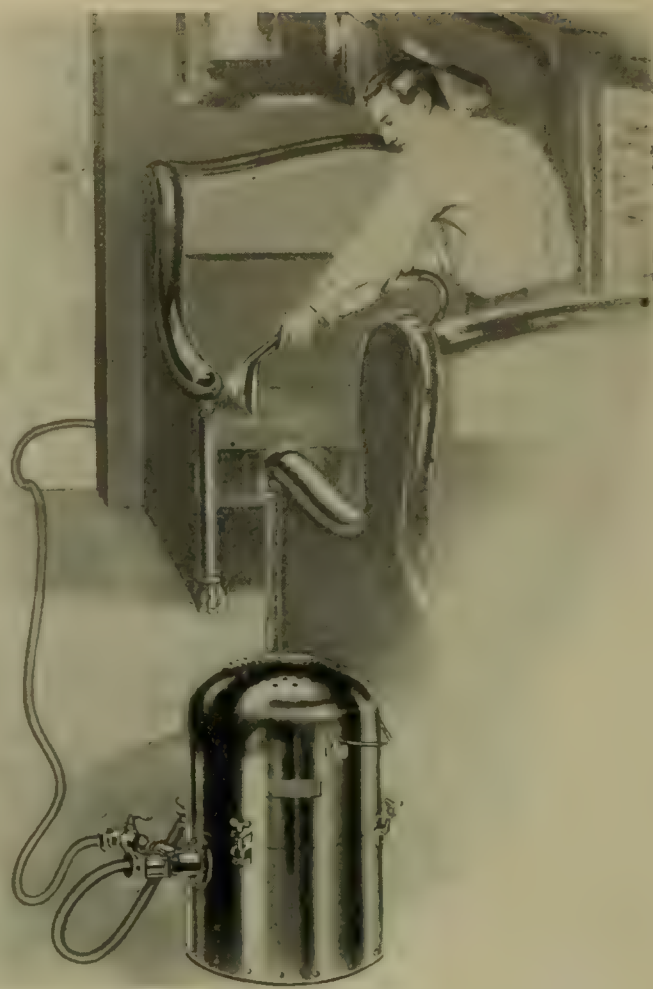
in the illustration. This tank can easily be carried by one man and it therefore requires but 25 feet of one inch vacuum hose.

The compressed air is first used to blow cinders and dust out of the crevices as the vacuum tools cannot reach them in out of the way corners. After this work is done the compressed air hose is attached to the vacuum producer and the cushions, bedding and floors are cleaned by suction. The cost of the apparatus is low and the equipment includes all tools necessary to properly clean passenger cars.

The "type A" outfit is made of pressed steel in two parts, to which is attached the aspirator or vacuum producing apparatus. The aspirator has an orifice ⅛" in diameter, through which the compressed air passes and produces a large inrush of air with at least 12 inches of vacuum mercury column. The dust screening apparatus on the inside of this tank consists of a novel arrangement of the cloth so as to get a large area in a small space. The tank is emptied from a screw hand hold at the bottom. The bulletins explain how the system works. A compressed air supply of from 60 to 75 pounds is ample, about 20 cu. ft. per minute being required for each cleaner.

On many interurban electric lines the air supply is obtained from the air brake pump when the car is in the terminal; while on steam roads, the air supply is obtained from the pipe line in the terminal yards.

The Chicago & Alton, Louisville & Nashville, Grand Trunk Pacific and some other roads have been using these devices for about five years. On the Chicago & Alton, at the St. Louis yards, it is claimed that one man can clean fourteen regular passenger coaches per day. The system is also in use on the Wheeling and Lake Erie, Delaware & Hudson, M. K. & T., Imperial Railways of Russia, International Sleeping Car Company, Paris, France, and many other roads in this country and Europe.



Compressed Air-Vacuum Car Cleaner Operating on Car Seats.

HALL-SCOTT MOTOR CAR.

A gasoline motor car for railway passenger service, a number of which have been in successful operation for several years, is shown in the accompanying illustrations.

The car is radically different in design from others which are manufactured commercially in that, while direct mechanical drive is employed, the engine is mounted on the car body and is not subjected to the more or less severe vibration of the trucks.

The automobile principle of transmission is employed as will be seen by inspection of the drawing. The drive consists of a steel shafting in two sections running directly from the gasoline engine to the transmission on rear truck. The first portion of this shafting is suspended between two 7" I beams running entire length of car, and is supported upon babbitted journal boxes, which in turn are securely bolted to the 7" members. The second section is a short shaft with toggle and slip joints at either end to take care of the side, and up and down motion of the truck. This shafting and toggle joints are of such heavy construction as to allow of continuous service without attention, excepting to keep shaft boxes and joints filled with grease.

Connection between the engine and shafting is by means of a split, steel band clutch lined with a non-burn material, located in an accessible position in engine room, and actuating upon a cast steel pulley. Clutch operation is by hand or foot lever, allows of absolute clearance of the band when in release position without drag, a maximum amount of slip without burning, and a positive lock when thrown into holding position.

Connection between the shaft and driving axle is by means of an axle mounted transmission, allowing of four selective type speed changes, in either direction, without reversal of the engine. The transmission is built up of three cast steel casings securely bolted together, of a design to allow of easy access to the driving gears. The transmission is suspended upon the front axle of rear truck in the same manner as found in electric motor axle suspension, with journal boxes cast integral with the steel case and removable journal brasses. The third point of suspension is by steel nose support resting upon hardened flat steel members. The spur and bevel gears used in transmission are cut from high carbon cast steel or steel forgings, as has been found best suited to their position and the work imposed upon them, heat treated and hardened. The transmission drive shafts are machined from solid billets of forged steel and heat treated. These shafts are supported at ends in roller bearings. All of the drive gears run in a bath of oil, the case being oil tight and dust proof.

Following is a table showing conservative figuring covering the cost of operating Hall-Scott type M-6, 150 H.P. gasoline motor car

Hall-Scott Composite Motor Car.

Hall-Scott Motor Car With Trailer.

equipment, using distillate for fuel:

Cost per mile for distillate	$0.023
(Figuring distillate at 8c per gallon, and operation of three miles on one gallon.)	
Cost per mile for lubricating oil	.008
(Figuring lubricating oil at 40c per gallon.)	
Cost per mile for operators	.044
(Figuring salaries to conductor and motorman at $200.00 per month.)	
Cost per mile repairs and renewals	.010
(Figuring $50.00 per month for all repairs and renewals to car body, trucks, and power plant.)	
Cost per mile for depreciation	.025
(Figuring 10 per cent per year on cost of car at $14,000.)	
Total operative cost	$0.11

It is especially noteworthy that this four speed change transmission allows of a remarkable flexibility in control, the handling of a heavy tonnage of rolling stock in yard switching, handling trailers over grades, and other heavy work which has heretofore been thought impossible for the motor car, and at the same time provides a high gear ratio so that the car may be operated at a high speed for level track work.

The car bodies are constructed according to the specifications of the railway companies and the cars are entirely built in the shops of the Hall-Scott Motor Car Co., which are located at West Berkeley, Calif. The offices of the company are in the Crocker Bldg., San Francisco, Calif.

ALL STEEL SELF OILING WAREHOUSE TRUCKS.

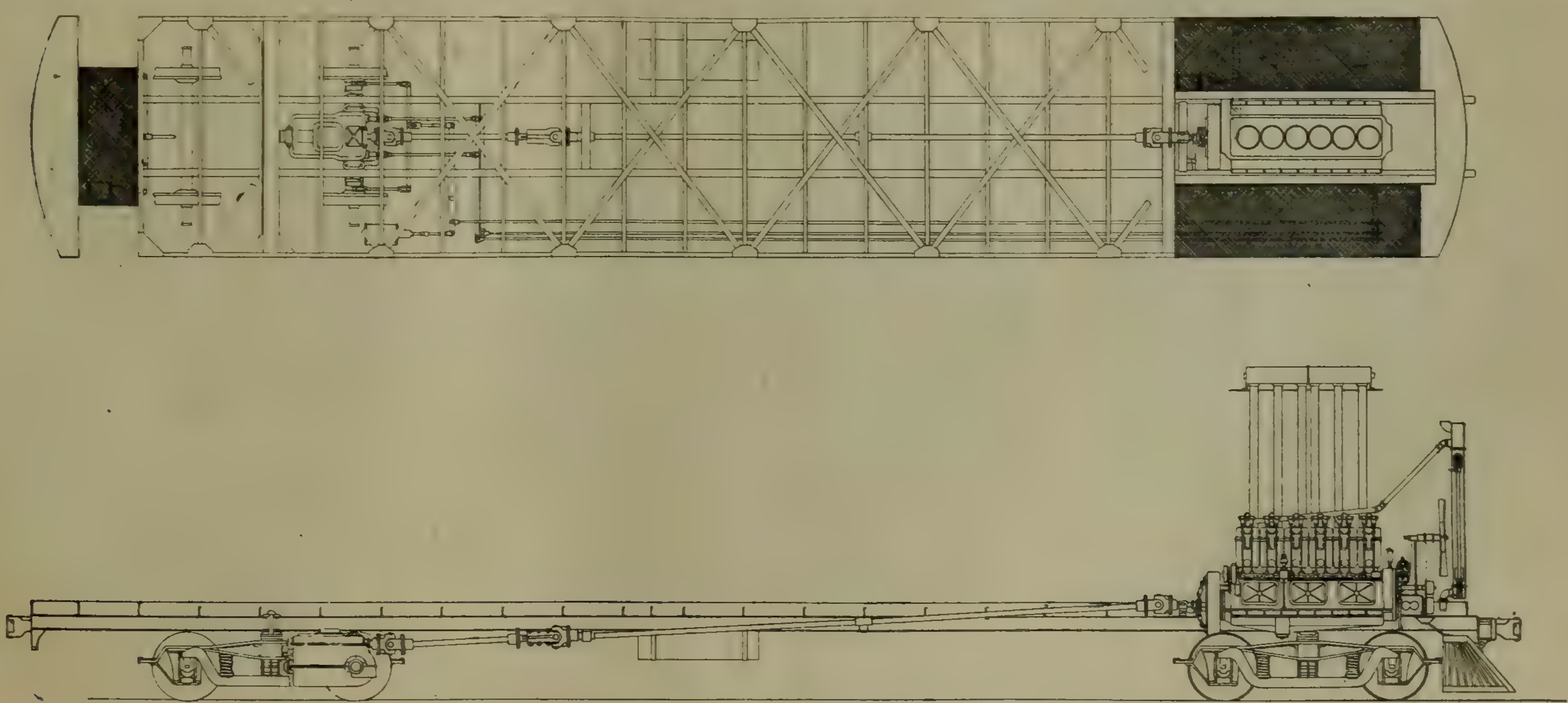
The manifest superiority of steel trucks for heavy warehouse duty as compared to those made of wood has been demonstrated, and when to this feature is added in combination self-oiling bearings, replaceable handles and removable bushings or bearings, the result would justify the claim of the manufacturer that nothing has been left undone to reach the ideal of truck construction.

The St. Louis Truck & Manufacturing Company is offering 24 standard models of 2-wheel trucks and 30 standard models of 4-wheel trucks that embody these important features. The nose-piece and side bars are forged in one piece of open hearth steel, thereby forming one solid frame, having no welds to weaken and break under load and no bolts to loosen. The crossbars are made of high carbon angle steel hung over sides of truck frame and riveted to it, and form a pocket for the short wooden handlebars. These wooden handlebars are held in place without being bolted or drilled, thus getting the full strength of the fibre of the wood and absorbing the vibration of the truck before it is communicated to the hands of the operator. The pedestals are provided with removable bushings or bearings, and the entire truck is so constructed as to provide for instantaneous repair with the use of a wrench only, and without putting it out of service for a moment.

These trucks are in service on many railroads, and are being marketed through the Kelly-Derby Company, Chicago, and The Van Nest Company, New York City.

GRIP NUTS ON KNUCKLE PINS.

In the running gear of a locomotive the necessity for reliability in the fastenings of the rods, is, of course, paramount. The Grip Nut Company, in the development of a knuckle pin nut has been subjected to criticism, but the experience of such railways as have

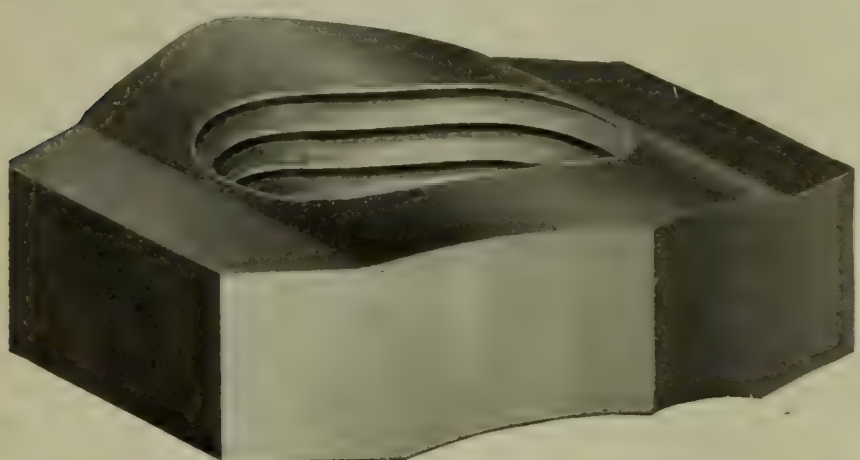


Plan and Elevation of the Chassis of the Hall-Scott Motor Car, Showing Power Plant and Transmission Arrangement.

All Steel Trucks.

adopted the grip nut for application to the pins has been such as to dispel all fear of its failure.

One road has had its engines equipped with grip nuts in this application for more than a year, and the advisability of the practice was determined after numerous experiments, the success of which removed all doubt as to the safety of the equipment. It is stated that twelve railways now have from one to fifteen engines, each, so equipped.



Grip Nut Designed for Locomotive Knuckle Pins.

The nut as designed for knuckle pins is illustrated herewith. In application it is set up against a thin nut of standard thread. While it is not necessary to jam the nut in turning it on, the railways in some cases have made this the practice. The resistance to removal is so great in either case that there can be no chance for its working off with the vibration of the moving parts.

The Selling Side

EDWARD F. WILLIAMS, formerly disbursing officer of the Panama Canal and treasurer of the Canal Zone, has been elected treasurer of McCord & Co.

THE RAILROAD WATER & COAL HANDLING CO. has been formed, with offices at 537 South Dearborn street, Chicago. The officers are: M. D. Miller, president; T. S. Leake, vice-president, and W. F. Leake, secretary and treasurer. Each of the officers has had a large amount of railroad experience, Mr. Miller having had twenty-six years' experience in railroad water service; T. S. Leake thirty-three years' experience with buildings and coal chutes, and W. F. Leake twenty-two years' experience with buildings. The firm will construct water and coaling stations, make investigations concerning water supply, design treating plants and handle a general line of pipe and fittings, water tanks, gas engines and pumps.

R. E. DERBY has severed his connection with the Kelly-Derby Co., Chicago, and will engage in another line of business.

W. A. ALLEN, formerly with the Carnegie Steel Co., has been employed as commercial engineer for the R. D. Nuttall Company, Pittsburgh, Pa.

ROBERT M. SMITH, formerly general sales manager of Mudge & Co., has opened a sales agency in New York City.

L. M. WOOD has accepted a position as sales manager of the Menominee Elec. Mfg. Co., Menominee, Mich., manufacturers of fans, vacuum cleaners and small motors. He was formerly with the Wesco Supply Co.

T. A. GRIFFIN, president of the Griffin Wheel Company, Chicago, has been elected chairman of the board of directors, and W. H. Snedaker, local manager of the company's plant at Tacoma, Wash., has been elected a vice-president, with office at Tacoma.

F. L. WHITCOMB has been elected president of the Griffin Wheel Co., with office at Chicago, Ill., succeeding Thomas A. Griffin. Mr. Whitcomb was born at Worcester, Mass., and was connected with a wool house in Boston from 1882 to 1884. Later he engaged in the boot and shoe business at Cleveland, O. From 1886 to 1888, he was in the purchasing department of the Atchison, Topeka & Santa Fe at Topeka and Chicago. He has been with the Griffin Wheel Co. since 1888 and was general sales agent until 1909. In 1909 he was elected vice president, which position he held until his recent appointment.

THE AMERICAN MASON SAFETY TREAD COMPANY, of Boston, was awarded a gold medal at the International Exposition of Safety and Sanitation, held during December in the Grand Central Palace, New York City.

THE PITTSBURGH STEEL PRODUCTS CO., of Pittsburgh, Pa., has opened an office at 1933 Railway Exchange Building, St. Louis, Mo. It will be in charge of A. F. McCoole, manager of sales, and C. F. Palmer, supervisor.

THE SOLVAY PROCESS CO. has moved its New York office from 100 William street to the 42nd Street building, Madison avenue and 42nd street.

J. W. HIBBARD, treasurer of the Grip Nut Company, with office at 500 Fifth avenue, New York, retired from the business of that company on November 1 and is taking advantage of this opportunity to take a much-needed rest and will spend a year or two in travel in an endeavor to improve his health.

T. N. JACOB, of East St. Louis, Ill., the chief engineer of the East Side Levee and Sanitary District of that city, from its organization, has resigned to engage in private practice, with office at the Cahokia building, East St. Louis, Ill.

THE RAILWAY UTILITY COMPANY, Chicago, has discontinued its branch office in Vancouver, B. C.

THE HYMAN-MICHAELS COMPANY of Chicago has secured a contract for 300 tons of 80 pound rails to be used in the concrete construction of the U. S. sub-treasury vaults now being built at San Francisco. This firm makes a specialty of taking railway scrap material and putting it into shape in its own plant. The plant is completely equipped with cranes, acetylene cutting apparatus and shears, and recently a standard inspection bureau has been installed in connection with the rail department. The Hyman-Michaels Company is composed of the Block interests of the Block-Pollak Iron Co.

JOHN P. NEFF has been elected a vice-president of the American Arch Co. Mr. Neff was born at La Fontaine, Ind., May 2, 1874. In 1895 he was graduated from the mechanical engineering department of Purdue University and entered the service of the Chicago & North Western as a special apprentice. During the greater part of his special apprenticeship he was in charge of the locomotive testing plant where a very considerable amount of research work was being carried on. Following this he served as a machinist; assistant roundhouse foreman at Chicago; division foreman of the motive power department at Waseca, Minn., October, 1899, to May, 1901; master mechanic at Huron, S. D., May,

W. L. Allison.

Alan Lichtenhein.

Ralph G. Coburn.

1901, to September, 1902; master mechanic of the Western Iowa division, with headquarters at Boone, Iowa, September, 1902, to July, 1904. In 1904 he left railroad service to take a position as engineer of tests of the American Locomotive Equipment Company. In 1906 he was made mechanical engineer of that company, and succeeded to a similar position with the American Arch Company when it was formed in 1910. In March, 1912, he was made assistant to the president of the American Arch Company, which position he held until his recent election as vice-president.

Frank A. Purdy, who was recently appointed sales manager of the Gold Car Heating & Lighting Company, and the Canadian Gold Car Heating & Lighting Company, joined the sales force of the former concern in 1905. When the latter company was organized, January 1, 1907, he was appointed its manager and has held that position until his recent promotion.

William L. Allison has been elected a vice-president of the American Arch Co. Mr. Allison was born near Salisbury, N. C., March 20, 1876. He was educated at the Davis Military School, Winston-Salem, N. C., and received a United States Military Academy appointment, but did not graduate. He entered the government service as United States deputy marshal, which position he held for three and a half years. From March, 1898, to January, 1904, he was employed by the Baldwin Locomotive Works in various capacities, the last year of his service with that company being as engineer of tests. From January, 1904, to August, 1909, he was mechanical engineer of the Atchison, Topeka & Santa Fe, with headquarters at Chicago. In 1909 he became identified with the Franklin Railway Supply Co., and for two years was mechanical manager, with office at New York. Since that time he has been western sales manager, with office at Chicago, and has also been western sales manager of the Rome Merchant Iron Mills and the Economy Devices Corporation, and general western sales manager of the American Arch Co.

Walter H. Coyle has been elected second vice-president of the Franklin Railway Supply Co. Mr. Coyle was born at Salamanca, N. Y., December 27, 1878. Four years later his family removed to Meadville, Pa., and Mr. Coyle was educated in the public schools of that place. After leaving school he was for eleven years in the service of the Erie Railroad in various capacities in the mechanical and traffic departments. In January, 1905, he became identified with the Kent Manufacturing Co., Kent, Ohio, and in June of the same year entered the mechanical department of the Franklin Railway Supply Co., with headquarters at Franklin, Pa. In June, 1911, he was made assistant to the vice-president, with headquarters at New York, and was placed in charge of the sales department of the central territory, which position he held until his election as second vice-president, as noted above.

Ralph G. Coburn has been appointed eastern sales manager of the Franklin Railway Supply Co., with headquarters at New York. Mr. Coburn was born at Boston in 1882. He graduated from Harvard in 1904, and entered the service of the American Glue Co. He remained with that company about four years, being

J. P. Neff.

Frank A. Purdy.

Walter H. Coyle.

in charge of its western factories and having his headquarters at Des Moines, Iowa, and Chicago. On May 1, 1909, he opened the Chicago office of the Franklin Railway Supply Co., as resident sales manager. On June 1, 1911, he was made assistant to the vice-president, in charge of eastern-southern territory, with headquarters at New York, which position he held until his appointment as eastern sales manager.

ALAN LICHTENHEIN has been promoted to Canadian sales manager of the Franklin Railway Supply Co., with office at New York. Mr. Lichtenhein was born May 24, 1887, and is a graduate of both Williams College and the Harvard Law School. Upon the death of his father, who for many years occupied a very prominent position in the Canadian railway supply field, he entered the service of the Franklin Railway Supply Co. in Canada, and now succeeds to his father's position in charge of Canadian sales of that company.

E. M. CHADWICK, formerly with the Fairbanks Co., has been appointed manager of the Buffalo branch of Manning, Maxwell & Moore, railway and machinists' tools and supplies and electric traveling cranes; and D. A. Hamilton, formerly with the Reed Prentice Company, of Worcester, Mass., has been appointed assistant at Manning, Maxwell & Moore's Detroit branch.

At the First International Exposition of Safety and Sanitation,

Frank M. Gilmore.

held recently in New York, the American Abrasive Metals Company was awarded a gold medal diploma for its Feralun Safety Treads which have extensive uses for anti-slip surfaces where people must walk.

OBITUARY.

FRANK M. GILMORE, president of the E. D. E. Co., died at his home in Chicago on December 18, of Bright's disease. Mr. Gilmore was born 49 years ago, at Boston, Mass., but had made his home in Chicago for the past 22 years. A considerable portion of this time was spent with H. W. Johns-Manville Co. About two years ago he left this firm to organize the E. D. E. Co., dealing in car insulation and refrigerator car specialties. He was well known in the railway field, especially through the South and Southwest, where he traveled for many years while with the H. W. Johns-Manville Co. His death was sudden and his many friends will greatly miss him.

ROBERT C. TOTTEN, president of the Nickel Chrome Chilled Car Wheel Co., has passed away. Mr. Totten was born in Pittsburgh on January 6, 1833, and lived in that city most of his life. His father was one of the earliest founders in Pittsburgh and organized the old Fort Pitt Foundry. In 1850, Mr. Totten, at the age of 17 years, entered the foundry and continued in that business until about 1891. Since that time he had been engaged to a greater or less degree in the study of metallurgy, in connection with improvements in chilled iron castings.

EDWARD L. ADREON, SR., vice-president of the American Brake Co., died at his home in St. Louis on December 29. Death was sudden and was due to the bursting of a blood vessel in the stomach. Grief over the recent death of his son, E. L. Adreon, Jr., undoubtedly had affected him also.

Mr. Adreon was born in St. Louis on December 23, 1847, and was educated at Wyman's St. Louis University. He entered the

E. L. Adreon. Sr.

office of the comptroller of the city of St. Louis in 1865 and remained there twenty years, being twice elected to the office of comptroller during the period from 1877 to 1885. From April, 1887, to 1910 he was vice president and general manager of the American Brake Co., and since that time has been vice president of the company. Since 1888 he has also been southwestern manager of the Westinghouse Air Brake Co.

In the past he has held the following offices: Secretary and treasurer, Westinghouse Automatic Air & Steam Coupler Co.; director, Adreon & Co.; president, Railway Supply Manufacturers' Association; president, Emery Pneumatic Lubricator Co.; vice president and director, Broadway Savings & Trust Co. He was a member of the following organizations: Business Men's League, Manufacturers' Association, Latin-American Club, St. Louis Republican Club, Noonday Club, Mercantile Club, St. Louis Club, Missouri Athletic Club, Adirondack League, Sons of the American Revolution, St. Louis Railway Club, Aero Club, Air Brake Association, Masons, A. O. U. W., and Legion of Honor.

Mr. Adreon combined in a most eminent degree the qualities necessary to the successful manager. In addition to his thoroughness, his insistence on prompt and correct work, he had the human qualities that endeared him to his subordinates—geniality, kindness, magnanimity. He inspired them with enthusiasm and loyalty, and there are few if any managers who have been able to get out of their employees so much work done in the same devoted spirit. They might not have done it for an impersonal company, but they did it gladly out of their personal regard for Mr. Adreon. His dealings with the patrons of the company were always marked by fairness and liberality, and the good impression thus made on the railroad and locomotive companies of the country has been a business asset beyond computation. Without in the least disparaging the able labors of others, it must be set down as a fact that to Mr. Adreon more than to any one man is due the success and present high standing of the American Brake Co. For a quarter of a century he was with it as its guiding spirit; to it he gave the best endeavors of his life, and it stands a living monument to his genius, energy and devotion.

RAILWAY MASTER MECHANIC

**The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878**

Published by THE RAILWAY LIST COMPANY

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DALTON RISLEY, West. Mgr.

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, \$2.00 a year; to foreign countries, \$2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, February, 1914 No. 2

CONTENTS.

Locomotive Tests in Service.

The tests of locomotives as run on testing plants have resulted in the obtaining of much valuable data which has assisted in the improvement of design. Many of these tests are laboratory experiments and could be carried on nowhere else. But others are such as could be carried on while the locomotive is in service, and certain of them could be made perpetual. In the efforts for economy in fuel, firemen have been instructed as to best methods in performing their duties, but it is impossible to produce absolute and indisputable evidence that certain methods are economy-producing ones and not simple hobbies of persons in authority, unless the coal is checked carefully at both ends of the trip, and even then unequal conditions may be found in explanation of results good or bad.

In large power plants an absolute check on firemen is obtained through an analysis of the stack gases; this being made a continuous process. At first thought such a system would seem impractical of application to locomotives. By means of a simple outfit, however, a sample of the front end gases can be obtained in such a manner as to form an average for the trip. An equally simple analyzer installed in the roundhouse can then be used to show the results of the trip in the nature of the gases passed off. This system gives an absolute check upon the results of different methods of firing and, by comparison, upon each fireman. Moreover, it produces the evidence which obviates argument. The results of the analysis may be posted daily and a rivalry among firemen thus created. Where poor results are consistently obtained from man or machine the trouble can be easily located and corrective measures immediately applied.

In the operation of mechanically fired or oil-burning engines, the system above mentioned would be of great value in making adjustments of the apparatus. It would also produce evidence as to the condition of arches, tubes and front end apparatus in all cases.

It is, in brief, not at all improbable that certain tests of this nature are too generally considered as practical only in the testing plant in comparing and improving designs for new power, whereas they could often be used in raising and maintaining standards of economical operation.

Train Handling.

All railways which have for the past few years kept pace with the times in the adoption of heavier power each year have met with serious embarrassments, in the handling of the consequent long trains. Draft gear troubles have increased alarmingly and the handling of trains by engine crews has necessarily been placed under much closer supervision than in the past. One of the difficulties of the situation, however, seems to lie in the fact that there are few who can be found to supervise properly. The problems of both air brake and draft gear manufacturers in developing equipment to stand the rough handling of trains by enginemen who cannot understand or will not work according to the rules of good practice, are impossible of solution.

A paper covering this subject was read by F. B. Farmer before the Western Railway Club on January 19. In the paper Mr. Farmer has presented suggestions and rules governing the

operation of long freight trains, which have been found to work very satisfactorily. He places emphasis upon the importance of calling for detailed reports of each break-in-two from both engineman and conductor, and presents forms for these reports. The paper is published in abstract on another page of this issue. By calling for detailed reports from the enginemen, Mr. Farmer hopes to impress upon them a sense of responsibility not otherwise felt.

There can be no doubt that the frequence of recurrence of break-in-two troubles may well be viewed with alarm, and unless definite action is taken in reducing their frequency the further increase in the length of trains and consequently in the development of heavier power will be considered impracticable. Those lines which make a practice of refusing to haul small and light cars are not free from trouble of this kind, and it might be safely stated that draft gear damage is not greatly reduced. There is a logical reason for this—a combination of faulty inspection and careless handling will destroy the best of draft gear even if it does no worse.

Enginemen must be shown wherein their methods are wrong and by actual demonstration. And it is an unfortunate fact that, owing to the rapid strides in the design of heavier power, there are not enough skilled demonstrators. This may be illustrated by the experience of a certain large road which required reports from enginemen and which was consequently attributing about 90 per cent of its break-in-two troubles to burst air hose. That was the notation on each report. And until it was demonstrated by a bright young road foreman that a burst air hose need never cause a break-in-two, this excuse was accepted. In proving his point this man hauled many long freight trains without draft gear trouble even when faulty air hose frequently set the train brakes. His alertness in promptly shutting off steam and lapping the engineer's valve when he felt the drag of an unexpected application invariably saved breaking in two. Thereafter the officers of this road refused to accept the "burst hose" excuse.

Another excuse, frequently given by enginemen who are required to make out reports, is faulty inspection which allows him to leave a terminal with draft gear which has previously been damaged. This excuse is now no longer accepted on the above-mentioned road. Incoming as well as outgoing trains are "stretched" by clubbing a few brakes at the rear end and working the locomotive. "Long necks" are located and the damage can thus be charged to the crew which brought the train in or to the switching crew which handled it, as the test may show. If no "long necks" are allowed in an outbound train, a break-in-two cannot be charged to previously defective draft gear. Another advantage which is gained by stretching outbound trains before leaving the terminal is that of locating serious air leaks which are not evident until the slack is pulled out. In cold weather the rubber of the hose and connection gasket is stiffened and when the train has stood for some time with the slack "bunched" an attempt to pull out will develop leaks which will cause the brakes to set after the train has perhaps traveled for some distance. If the slack is pulled out against hand brakes tightly set at the rear end and then an inspection is made the leaks can be located by the same inspection that locates "long necks."

If enginemen are, in standard practice, to make out detailed reports it is necessary, if proper results be obtained, that they shall be studied by men who are qualified to actually *demonstrate* where the excuses are not acceptable and to teach better methods.

Industrial Railways.

The American people are as a class fair minded and the methods used by the daily press in treating certain subjects often causes doubt in the mind of the thinking man as to its proper representation of the public in this country. Those associated with the railways probably have more reason than those associated with any other industries to wonder at the attitude of the press in treating upon subjects which concern the railways.

It is only recently that articles appeared simultaneously in the leading daily papers of the country to the effect that several of our largest systems have been caught in a species of "rebating." It would not be surprising, if it were possible to know, if hundreds of thousands of minds had formed the opinion, based upon these items, that the railways are still open to criticism with respect to such matters.

It is only in later issues of these same newspapers, if at all, that it is explained that the railways themselves instigated an investigation on the part of the Interstate Commerce Commission into the particular species of rebating above referred to. It is well known among business men that the larger industrial concerns have built and maintained their own railways for the purpose of obtaining allowances from the large railway systems in the form of switching charges and per diem rates on cars. The advantages of this practice on the part of large manufacturers have been so great as to encourage a very large increase in the number of railway companies incorporated to operate plant tracks and locomotives, and have led to a situation which has become embarrassing in several respects.

The Pennsylvania, the New York Central, the Baltimore & Ohio and the Erie have filed briefs on this subject with the Interstate Commerce Commission for the purpose of obtaining a ruling as to the legality of the practice, and it is probable, as a result, that all allowances for the performance of this class of service will be abolished. There was absolutely no secrecy about any phase of the subject, as has been publicly stated by Samuel Rea, president of the Pennsylvania system. It is plain to see, therefore, that another grave injustice has been done the railways generally by the method used by the daily press in handling the subject. The probable outcome of the matter will be the disbandment of most of the railway corporations formed for the purpose of operating manufacturing plant tracks, as there will be no further incentive for their existence.

Keeping on the Subject.

Within a few months the open season for railway conventions will be with us again. Men from every department of railway activity will journey to various meetings to obtain new ideas, to get inspiration and to make new friends. Without doubt the man who conscientiously attends the sessions of his association is going to be a more valuable man for the railway company, and those at the heads of mechanical departments should encourage attendance on the part of their men.

However, it frequently happens that those who take part in the discussions are so full of ideas that quite often they wander

away from the subject which is under discussion. In order that a convention may obtain the greatest amount of good out of its proceedings, the members should be required to confine themselves strictly to the subject before the house. Those who are to preside at meetings during the coming summer can do a great deal to make the sessions of their respective associations of greater value by insisting that one subject be handled at a time.

Not only do individuals have a tendency to stray away from the subject, but the associations as a whole occasionally do the same thing. The committee on subjects can do a great deal of good in many cases by seeing to it that the association itself sticks to the subject to which it is devoted. Criticism has sometimes been directed at some associations because the subjects taken up were outside of or beyond their field, and frequently the criticism has been justified. It is indeed very proper for men to study problems with which they may come in contact in the future, but this should be done outside of an organization which is devoted to the work of a particular set of men. Let subject committees consider first just who are members of the association and what they are doing—then go ahead and decide on subjects in which they are directly interested every day in the year.

Statistics for Mechanical Officials.

We present on another page an interesting article on "Statistics for Mechanical Officials," by Ernest Cordeal. It is true, as stated in the article, that "if a high degree of efficiency is to be maintained in the operation of a railroad, the mechanical department must bear the largest share in its accomplishment." In no department can statistics and records be used to such good advantage as in the mechanical department, for it in reality is the manufacturing end of railroading.

However, statistics are not of very great value to the busy superintendent of motive power unless they are put into such shape that he can tell at a glance, almost, how his costs, performances, etc., are running. A diagram will convey more to the mind in a minute than the actual figures will convey in fifteen. Mr. Cordeal gives a number of interesting points with regard to the form of chart adapted to convey the information quickly and completely.

Representatives of Westinghouse, Church, Kerr & Co. of New York, who built the Orient railroad shops at Wichita, Kan., are drawing plans for increasing the capacity of the shops. The present shops now employ 200 men and if enlarged under the plans now being made, the payroll would provide for 1,800 men.

The Oregon-Washington Railroad & Navigation Co. will ask for bids for a $575,000 steel swing bridge across the city waterway at Tacoma, Wash.

The Pennsylvania Lines West are considering plans for grade crossing elimination at Lima, O.

The Seaboard Air Line will soon begin work on important terminal improvements at Savannah, Ga., which, it is said, will involve an expenditure of $500,000.

Railroads entering Spartanburg, S. C., are preparing to erect a union station there.

Work will be started in the spring by the Nashville, Chattanooga & St. Louis on the East End viaduct at Chattanooga, Tenn.

The Norfolk Southern will build an engine house at Raleigh, N. C.

Twenty Years Ago This Month

(*From the Files.*)

F. N. Hibbits has been appointed master mechanic of the Erie at Rochester, N. Y.

It was recently stated in the daily press that President Reinhart, of the Atchison, Topeka & Santa Fe, had been presented, by the Pullman Palace Car Company, with an elegant private car. President Reinhart desires to have it known that neither the Pullman company or anyone else has presented him with a private car or anything else.

The Lehigh Valley has introduced a dining car on its through train to the West.

Jerome metallic packing, manufactured by C. C. Jerome, of Chicago, has been made standard on the Illinois Central locomotives.

The corporation organized to build a railway from North Dakota to the Gulf was sued by its young lady stenographer for an unpaid salary balance of $15, thus puncturing the scheme.

The Austrian railway authorities have issued a circular to private railway companies urging experimentation in the electric lighting of cars.

The Grand Trunk is considering the substitution of electric locomotives for the special hard coal-burning steam locomotives now operating through the St. Clair tunnel.

The Chicago, Rock Island & Pacific plans to use compressed air to clean its coaches.

The Chicago Railway Equipment Company, lessees of the National Hollow Brake Beam Co., has certified to an increase of capital stock from $150,000 to $250,000.

The Wabash will make a trial on one of its locomotives of the Lewis valve gear after a design furnished by J. B. Barnes, superintendent of motive power. The gear is reported to be operating with success on the Vandalia.

COMPENSATION OF LABOR ON BRITISH AND AMERICAN RAILWAYS.

With wages one-sixth to one-half the scale forced on American railways by successive arbitrations at the point of the strike bayonet, British railways, with the approval of Parliament, have been permitted to meet small advances in the pay of employes with increased passenger fares and freight rates.

Hitherto it has been difficult to present in convincing form the disparity between British and American railway wages so as to show in their true contrast the fundamental differences existing in economies of construction and operation. This difficulty has been removed by the report just made by the British board of trade presenting terms of settlements in railway wage disputes during two years' operation of the amended railway conciliation scheme. At a time when the relation of railway wages to railway rates has become of such engrossing interest in this country, it renders possible the measurement of American railway pay by British standards presented in the following statement showing the daily rate awarded British employes compared with 1912 average earnings per man in the United States:

	Great Britain Minimum	Great Britain Maximum	United States Average
Enginemen	$1.15	$2.18	$5.02
Firemen	.73	1.46	3.03
Conductors	.77	1.42	4.29
Trainmen	.63	1.42	3.02

Herein are set forth the actual earnings of four great classes of American railway labor in 1912, to which further additions have already been granted, compared with the new-won scale of British employes. For enginemen and firemen the services are almost identical, but conductors and trainmen here differ somewhat from the nearest British counterpart. American earnings, including overtime and extras, are used, it is true; yet their use against the British maximum is more than fair, for this is far

above the average. Actual earnings, computed as the American's, would be roughly a mean between minimum and maximum. According to latest determinations, in fact, $1.86 daily was the average earnings for engineers, $1.11 for firemen and $1.26 for passenger guards.

As British railway wage rates, devoid of all extras, have been impossible of ascertainment through lack of published figures, the chief value of the present report to the student of foreign railways lies in its exact data on actual scales of pay. Yearly English compilations, presenting only for a selected week the actual compensation paid by 27 companies in the United Kingdom, show only the average earned per man; there are available now, however, specific rates awarded the individual classes of employes in 219 wage disputes with additional information as to present conditions of service on British railroads.

Of the 219 settlements 107 were arrived at by agreement between deputations of the men and the companies alone; 93 by agreement between the two sides of conciliation boards without assistance of a chairman and 4 by such agreement with mediation of a chairman. Only in 15 cases was a chairman's decision required after efforts at agreement had failed. In each award the scale is to stand as a rule from 2½ to 3 years. The highest wage rate awarded to any class of railway servants was $2.18 daily or $13.08 weekly granted to engine drivers. This is to be compared with an average actual earning record in 1912 of $5.02 daily for enginemen of the United States; yet this British maximum wage not only is far beyond the generality of railway wages in the United Kingdom, but, as will be seen, it is in itself exceptional for even railway engineers. There are American roads where the daily compensation of enginemen averages $5.50.

Next highest in the wage scales set are signal fitters and telegraph wiremen, but the rate is that set for foremen of the class in London. So also, with few exceptions, other wage awards which attain to the region of $8.00 per week apply to foremen, the leading member of a gang, to some special member or apply only in the London district. From an average maximum far below that figure rates of payment drop to the $2.18 per week which in one case was awarded to a porter in southwestern Scotland. This too is an exception. Conciliation boards seem to have set 17 shillings per week ($4.13) as the general minimum for adult employes (although the minimum is broken also in certain cases of brakemen, carmen and vanguards, carriage and wagon examiners, checkers, engine cleaners, gatekeepers, greasers, number takers, permanent way men and shunters) and for "lads," as junior employes are termed, considered as apprentices, a minimum wage of 7 shillings ($1.70). For "lads" the maximum seldom is over £1 ($4.87) weekly.

As may be judged by the wide divergence between minima and maxima, unlike the practice in the United States no general wage rate applies to the same grade of railway labor. Two reasons explain the diversity: first, employes performing the same class of work with similar records of service vary widely in rate of pay because of difference in living conditions; secondly, employes performing the same class of work under similar living conditions vary widely because of difference in records of service. A graduated scale applies universally, in other words, itself adjusted to special conditions of special territories.

Lowest wage scales apply as a rule to Ireland, Scotland and the rural parts of England. Highest scales, on the other extreme, arise in the large cities where living costs are greater. So, in 1912, average weekly earnings of railway servants in Ireland were $5.04, in Scotland $5.91, and in England and Wales $6.80, the average for the United Kingdom being $6.65. The high record, $13.08, already mentioned in the case of engine drivers, applies to drivers of only a few long-distance trains on the Great Central Railway who reside permanently in London. Such men, receiving 3 shillings ($.73) per week extra in consideration of their metropolitan living expenses, so attain their exceptional rate.

It is from the graduated scale, however, that one best appreciates the slow, laborious ascent which marks the British railway servant's rise in the wage scale. Beginning at the set minimum, his advance almost universally is at the rate of 1 shilling (24 cents) per week annually toward the maximum of the grade, reached not unusually after from 15 to 20 years. The maximum of $8.50 for brakemen is attained on the North Staffordshire Railway after 18 years of service, which began at $4.61. The similar maximum for passenger guards is reached on the same road in the "twenty-second year in charge of trains." In that period the guard has risen from 24 shillings to 35 shillings per week, that is, from $5.83 to $8.50, a weekly addition in 22 years of $2.67!

Money wages, it is true, constitute not the whole of the British railroad man's compensation, yet other allowances total almost nothing. A special investigation of 1907, results of which were published recently, showed 204,237 adults and 15,915 lads receiving free uniform and other clothing; applied to all employes this was worth 8 cents per week for adults and 6 cents per week for lads. Free or reduced rent to 14,337 adults averaged for all employes 2 cents per week. Other allowances were of even smaller consequence. The British railway man is, moreover, allowed an annual holiday with pay varying with class of work and length of service from 3 to 6 days per year. Ordinarily, also, when required by work to lodge away from home temporarily, employes have been awarded "lodging allowances," which vary from 12 cents to 85 cents nightly.

It is significant, however, that in most cases where the bonus question has come up such extras in reward for added effort or efficiency are abolished at the request of the men in favor of the fixed advances demanded.

Though hours of labor differ among the many classes almost as widely as do wages, ranging from 47 to 72 hours per week, the ten-hour day seems to be regarded as standard. Brakesmen work ten hours a day; engine drivers and firemen, 10 to 12; gatekeepers, 9 to 11; goods guards, 10 to 12; and passenger guards, 10 to 11. Permanent way men work from 55½ in summer to 47 in winter, with Saturday half-holiday. Overtime, as a rule, is paid as time and one-quarter and Sunday, Good Friday or Christmas as time and one-quarter to time and one-half. Rare cases of double Sunday time occur.

What has been the total effect of these wage increases, already the cause for a rise in rates which has left few British railway charges untouched? Twenty-seven companies, employing more than 90 per cent of the railway servants of the United Kingdom, show these results:

Average Weekly Earnings of British Railway Servants 1903 to 1912.

First week in December.	Number employed in selected week.	Average weekly earnings per head.
1903	448,944	$6.04
1904	446,197	6.08
1905	449,923	6.14
1906	458,579	6.17
1907	479,314	6.27
1908	459,753	6.07
1909	459,968	6.16
1910	463,520	6.25
1911	473,168	6.48
1912	482,905	6.65

Advanced wages granted toward the close of 1911 by many of the important companies, followed by additional increases on other railways in 1912, brought a rise of 23 cents in the average weekly earnings per man for 1911 and a further rise in 1912 of 17 cents per week! The 1912 average is 38 cents higher than that for 1907, another year of good trade.

American railways, paying an average wage of $733 per year, confronted by demands for 20 per cent advances and awards of 7 per cent, would seem to bear at least as heavy a burden as did their British counterparts, since compensated with public approval for their 2.6 per cent increase to a yearly wage of $346.—*Bureau of Railway News and Statistics.*

Statistics for Mechanical Officials

By Ernest Cordeal.

The operating expenditures of a railroad may be roughly divided into two classes. First, those items which are comparatively fixed or in other words are not subject to decrease by improved efficiency of operation. Under this head would be considered such accounts as include the salaries of general officers, superintendents of the various departments, wages of dispatchers, station employes, engine men, trainmen and switchmen, also the accounts which cover depreciation and renewals. Second, those items in which economy may be affected by improved efficiency of operation. Under this head would be included all the repair and supply accounts.

Under the first classification many of the accounts are practically fixed regardless of the volume of business handled. This applies to the supervision accounts and the depreciation accounts. Expenditures for renewals depend upon administrative policy. The wages of dispatchers and station men are fixed within certain limits of variation. The wages of train, engine and yardmen vary directly with the amount of business handled. It is obvious that the accounts under this head do not present a field for the reduction of operating expenses, presupposing a fixed quantity of traffic to be handled.

Under the second head, on the other hand, are found the accounts which must bear the burden when improved economy of operation is desired. By dividing the total operating expenses of a railroad into two classes as outlined it will be found that approximately 50 per cent falls into the first class. An analysis of the remaining 50 per cent which falls into the second class reveals the fact that fully three-quarters of the total is included in the accounts which are handled by the mechanical department. Under this head are included the maintenance of equipment accounts covering repairs to locomotives and cars and the transportation accounts covering fuel, lubricants, supplies and handling of equipment.

It is therefore apparent that if a high degree of efficiency is to be attained in the operation of a railroad, the mechanical department must bear the largest share in its accomplishment.

Efficient, economic operation may be accomplished by continuous, competent supervision of expenditures included in the second class. In order that such supervision may be given it is essential that mechanical department officers, from the superintendent of motive power to round house foreman, be provided with accurate, current data reflecting performance in the various activities under their supervision.

Not only should records of current expenditures be provided, but further certain standards of performance should be established so that the actual figures may always be considered in their relation to the results expected.

The principal accounts with which the mechanical department has to deal, following the Interstate Commerce Commission's classification, are as follows:

Maintenance of equipment.
- Account 25—Steam locomotives—repairs.
- Account 31—Passenger train cars—repairs.
- Account 34—Freight train cars—repairs.
- Account 46—Shop machinery and tools.

Transportation.
- Account 72—Enginehouse expenses—yard.
- Account 73—Fuel for yard locomotives.
- Account 75—Lubricants for yard locomotives.
- Account 81—Engine house expenses—road.
- Account 82—Fuel for road locomotives.
- Account 84—Lubricants for road locomotives.
- Account 85—Other supplies for road locomotives.

Each one of the accounts enumerated is of such nature that constant, intelligent supervision of the expenditures therefor must be exercised in order that the cost of operation may be maintained at the practical minimum. The necessary data to assist and support such supervision should be furnished, first, as promptly after the end of accounting periods as possible, and second, in as brief and comprehensive form as possible.

The men who hold supervisory positions in the mechanical department are without exception loaded with a burden of cares and responsibilities which leaves them little time for the study of long, intricate statements or reports. Columns of figures, no matter how skillfully arranged, give up the salient facts only upon diligent study.

The graphical chart when properly designed presents the best, most complete solution of the problem of placing the pertinent facts before the interested parties in the most concise and definite form requiring the minimum of effort for their digestion. Charts should be so constructed as to throw the facts in the face of the reader. A graph which must be pondered over before it divulges the information which it contains is no improvement over columns of figures. The prime object, then, in the designing of graphical charts for the assistance of mechanical men should be to so simplify the form that the fact or facts presented are comprehensible with the minimum of mental effort.

The facts which should be brought out in the charts are:

First—The actual monthly expenditures to the various accounts.

Second—The cumulative average of the months contained in the fiscal period.

Third—The relation of the actual figures to a prearranged standard.

Exception may be taken by some authorities on the subject to the expediency of showing actual monthly charges without reduction to a unit basis whereby the expenditures are shown in relation to service rendered. For instance, they would demand that locomotive repairs be reflected as a cost per engine mile or per gross ton mile. Undoubtedly the cost per gross ton mile is the most equitable figure for comparisons of performance as between different roads, between different divisions of the same road, or between different periods of time, but such data as a guide for the supervision of current expenditures is practically useless. The supply accounts may be expected to follow very closely any variation in the volume of business handled, the handling accounts will also follow in a lesser degree, but the repair accounts may and frequently will be effected inversely. Undoubtedly the most economic repair costs may be obtained by adherence to a policy of operating locomotive and car shops uniformly throughout the year, insuring the maximum yearly output with the minimum capital investment in buildings and equipment, permitting the retention of a steady trained force of workmen and insuring the best condition of rolling stock at all times. However, whether the shops are operated uniformly or spasmodically in an attempt to regulate expenses to the variations in income, monthly repair costs per unit of service for the same period are of little value. Aside from the questionable value of monthly unit costs such a basis for use in conveying the necessary information to mechanical officials adds a complication which defeats to a large extent the purpose of the data, not only must simplicity be sacrificed but longer delays in compiling the data are unavoidable.

The use of the cumulative average should require little explanation. By this means monthly fluctuations are equalized and the general tendency of expenditure either upwards or downwards is indicated. The cumulative average is preferable to the twelve months average for the reason that while the former considers only expenditures for the present year the latter is influenced by the figures representing the months

of the previous year until the twelve month period has been completed when the last month of the previous year is eliminated. In a progressive world the records of past performance would be of little interest unless, perhaps for the emphasis of past errors to be avoided in the future. The comparison of present with past performance is as a rule a valueless makeshift. Efficiency should not be based upon what has been done but upon what should be done.

In order that it may be known what relation the performance of the present bears to the best possible attainment, in order that a definite mark may be established a record to be striven for, standards of performance should be prearranged. Such standards may be built up from the expected unit costs. The variation in the quantity of business handled from year to year is rarely so great as to render impracticable the setting of a fixed standard expenditure to cover any of the accounts under consideration.

A number of chart forms are here illustrated for the purpose of establishing the superiority of this method of presenting pertinent information. In addition to the form suggested as the best on account of its simplicity and the prominence with which the salient points are brought out, other more complicated forms are shown in order that certain comparisons may be drawn.

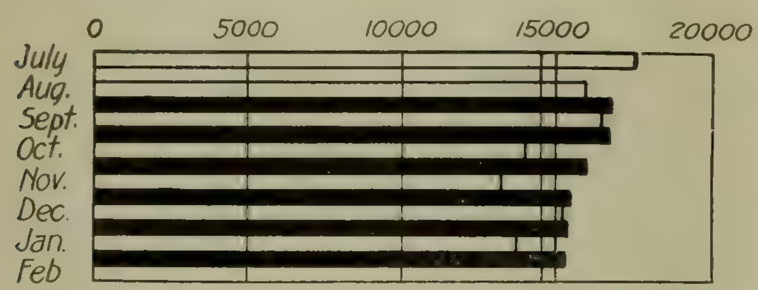


Fig. 1.

The first chart illustrated is that recommended for use. The arrangement of this chart is simplicity itself. The scale of amounts is given a prominent place at the top of the chart making it a matter of ease to determine the charges represented by the lines in the body of the graph. The monthly charges are represented by the open blocks and the cumulative averages by the solid blocks. The standard representing the result which is expected, is indicated by the vertical line which in the case illustrated calls for a monthly expenditure of $15,000 or more correctly for a total expenditure for the year of $180,000 it being understood that monthly fluctuations will occur which should, however, balance up in the average so that the final block representing the average monthly charges for the twelve months will fall close to the standard line.

This form of chart may be understood at a glance. When the figures for each succeeding month are added, together with the average, the graph becomes a perpetual memorandum to mechanical officials appraising them constantly and without effort on their part of the exact standing to date of each account represented.

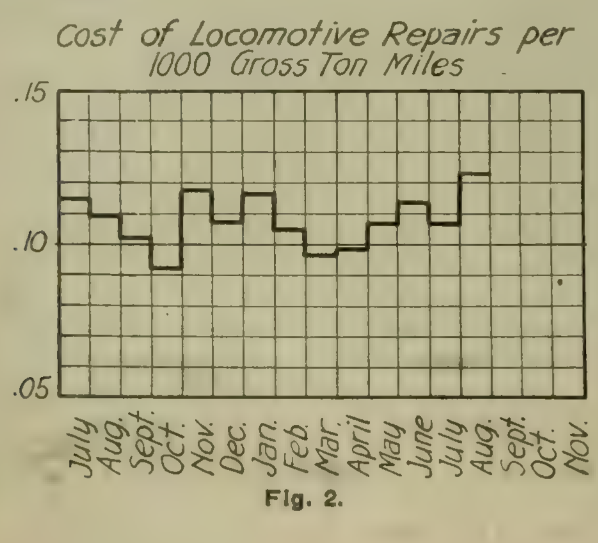


Fig. 2.

The second chart reproduced, illustrates a form often used and one which has certain advantages for certain purposes. The straight lines of this form share with the first graph the factor of simplicity which is absent in following examples where the curved or broken line is used. The chart as drawn introduces the double standard of cost and amount of business handled. As a historical record of performance or as a means of advising the higher officials of the tendency of unit costs from month to month and from year to year, this form is acceptable. As a chart to be put in the hands of officers in charge of a single division or point for their guidance in the every day conduct of affairs, it is far inferior to the first for the reason that the pertinent fact, of so much actual money spent, is not indicated with sufficient clearness.

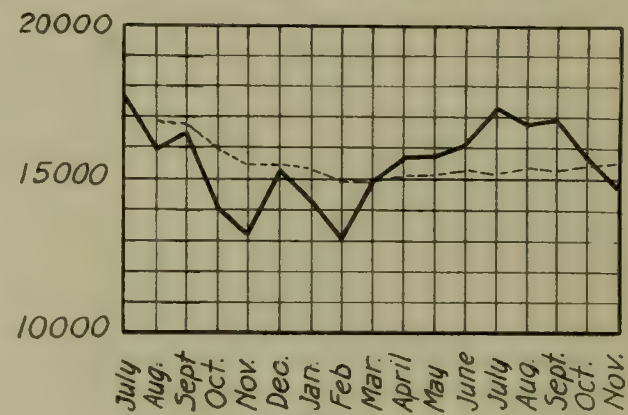


Fig. 3.

The third form illustrated, while it makes use of the monthly actual expenditures and can readily be completed by the addition of the line indicating the standard allotment, is not nearly so easily comprehended as the other forms. The curve or broken line in itself a thing more complicated fails to convey ideas with the abrupt, uncompromising clearness of the straight line. The twelve month average has been used in this chart to illustrate its disadvantages.

It will be observed that owing to the exceptionally low charges for the months of September to March the average line rises but little above $15,000 at the end of the chart although the expenditures for the months from April to October range from $15,700 to $17,200. Again the average line rises for the last month on the chart although the charges for that month are well below any of the preceding eight months the increase in the average being due to the fact that the previous November which is dropped when the current month is added, was abnormally low. The official who had watched carefully this average line and congratulated himself upon the fact that it had not risen above the standard allowed, would having been distinctly disappointed when with the last month's figures in, the average for the current year had appeared above the standard. No such false impressions as this would be possible when the cumulative average is used instead of twelve months.

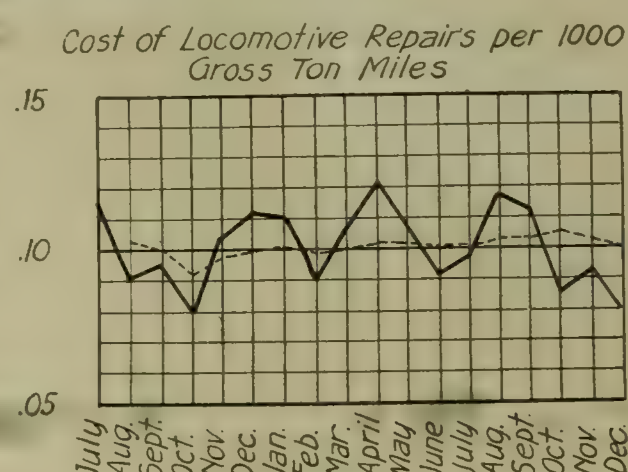


Fig. 4.

The fourth illustration combines the bad features of the second and third without retaining the good. The curved and

broken lines again hinder the rapid accurate reading of the chart while the introduction of the double standard of money and work performed renders the chart useless as an assistant to the man on the work. The twelve months' average completes the task of rendering the chart impracticable.

In consideration of the foregoing graphs it should not be understood that the forms which are designated as inferior for the purpose in hand may not have certain uses. It is simply as a means of conveying pertinent statistics to practical mechanical men that their usefulness is questioned.

40-TON ELECTRIC LOCOMOTIVE, G., P. & H. RY.

The Galt, Preston & Hespler Ry., Preston, Ontario, placed the 40-ton Baldwin-Westinghouse locomotive herewith illustrated in service on November 20, 1910, and since that date it has been in continuous operation, twenty-four hours every day, except Sundays, averaging about 150 hours per week. This service includes hauling practically every kind of freight in standard steam railway rolling stock, between the Canadian Pacific lines at Galt, Berlin and Waterloo, a distance of from 12 to 14 miles.

Although the haul is not long, there are a number of 2% to 2½% grades from one to two miles long. The maximum number of cars hauled in one train is about 25, the average number being 15, and the tonnage per train is about 200 tons, or on four trips of road per day, 2,000 tons.

It is hardly possible to estimate exactly the total mileage, as the greater part of the time, 16 hours per day, the locomotive is in switching service. No record is kept of the tonnage and mileage, but the switching mileage would easily equal half, if not three-quarters, of the road service.

This locomotive is equipped with four Westinghouse No. 308-B-2 commutating-pole, 600-volt railway motors, rated at 120 h. p., and unit switch control.

The locomotive is given one-half hour inspection every 24 hours, and about five or six every Sunday, when making light repairs, such as applying brake shoes, changing wheels for tire wear and inspection of motors, airbrakes and control equipment. Tires have been turned twice since this locomotive went into service, and the total repair account to date is given below:

Air compressor (principally due to armature and field trouble due to low trolley voltage)	$170.00
Tire turning	45.00
Motor axle bearings	30.00
Unit switch control	50.00
Trolley parts, wheels, harps, poles and bases	110.00
Brake shoes	270.00
Miscellaneous	30.00
Total (from November 30, 1910, to July 14, 1913)	$705.00

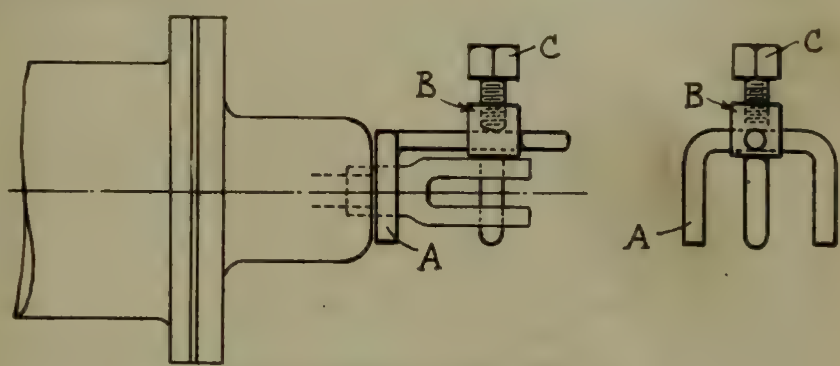
The total, $705.00, for repairs on this locomotive, covering a period of over 2½ years, is considered a very good record by the operating company, in view of the large amount of service received.

BRAKE CYLINDER HEAD HOLDER.

By J. A. Jesson.

In removing and replacing the non-pressure head and piston the head will usually spring away from the cylinder and it requires considerable force to hold it in position while replacing the head bolts.

The sketch shows a simple device that will overcome this objectionable feature and will prove a valuable addition to the brake cleaner's kit.



Brake Cylinder Head Holder.

It consists of a yoke A, which fits over the crosshead and against the cylinder head. Pin B fits in the brake pin hole, and set screw C holds yoke in position after adjustment to head.

THE SOCIETY of Railway Associations' Secretaries was formed at a meeting held in New York City on November 22, 1913. Another meeting will be held early in February.

40-Ton Baldwin-Westinghouse Locomotive—G. P. & H. Ry.

LOCOMOTIVES IN ENGLAND IN 1913.

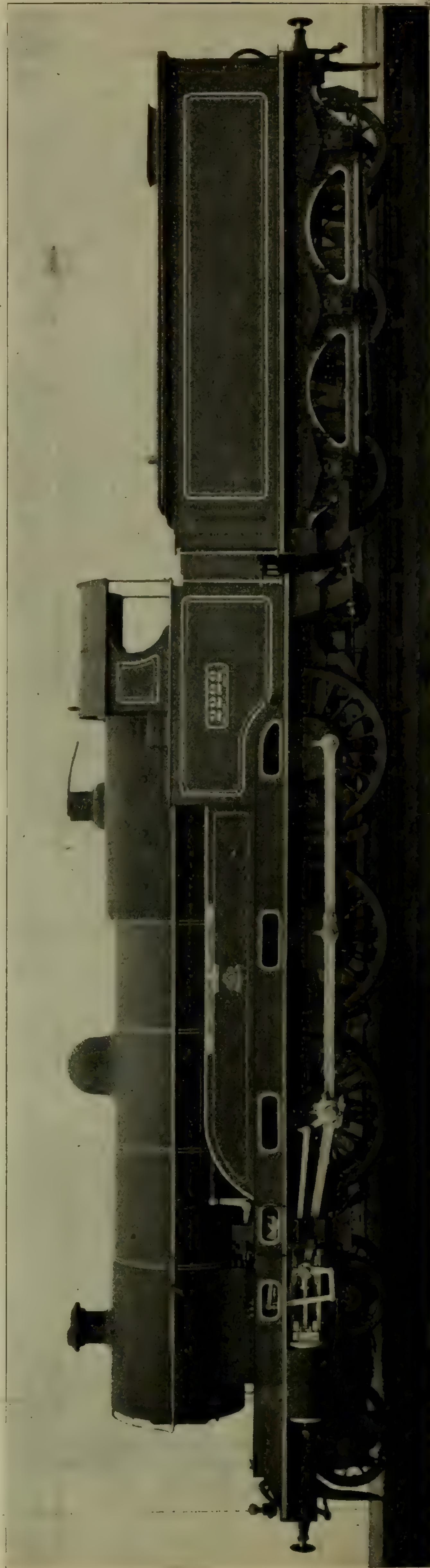
Looking back at the locomotive year in the United Kingdom there are seen points which, although not novel to readers of the *Railway Master Mechanic,* will bear recalling as indications of the lines of improvement followed. Take for example the introduction of an engine designed on the Stumpf principle. This steam cylinder had been very interesting to British locomotive engineers. It came along at a time when most of the people who devote attention to railway matters were prepared to regard the possibilities of improving the reciprocating steam engine as virtually non-existent; it is an instance of the result of school research work applied directly to an industry whose own practical men have fallen somewhat into the grooves of routine, and it is one of those rare cases of radical novelty in steam engine design being adapted immediately to the locomotice. The Stumpf engine was only announced in 1912 and early in 1913. Vincent L. Raven, the chief mechanical engineer of the North-Eastern Railway, had the principle embodied in and working an express passenger locomotive.

In the Stumpf cylinder piston valves admit steam to the cylinder, but the outlet for exhaust steam is through ports around the middle of the cylinder, the piston itself acting as an exhaust valve. The piston being very long, these ports are not uncovered until the end of the stroke is reached in either direction. It will be observed that the steam has a direct passage through the cylinder, instead of turning back to exhaust through the same port by which it entered. This means that hot incoming steam does not meet walls cooled by outgoing exhaust steam; consequently there is less loss by condensation and improved economy.

During the year the North-Eastern Railway's dynamometer car has been attached to a number of goods and express passenger trains hauled by the Stumpf engine between Newcastle and York. The weight of the passenger train was from 212 to 411 tons (one ton equals 2,240 pounds), and of the freight trains from 632 to 1,054 tons. The booked speed of the passenger trains varied from 48.6 to 51.6 m. p. h. and that of the freight trains averaged 24 m. p. h. The engine was quite capable of hauling the trains to the booked speed. The average coal consumption was 2.93 pounds per horsepower hour, and the average water consumption 20.71 pounds per horsepower hour. These averages are taken from the figures of ten express passenger runs from Manchester to York and four passenger and six goods runs from York to Manchester.

Few remarkable designs have been seen this year. The six wheels coupled passenger express engine is gradually improving its ascendency over the four-wheeled coupled. Super-heating is now so common that it has almost ceased to be interesting to the public.

During the latter part of 1912 C. J. Bowen Cooke commenced building a four-cylinder passenger engine of the 4-6-0 type, and in January of this year the Sir Gilbert Claughton, shown in the illustration, was put into service. The cylinders are 16 inches diameter by 26 inches stroke, fitted with piston valves 8 inches diameter, and all driven on to one axle. This arrangement of cylinders gives a more perfect balance than is possible when the cylinders drive on to separate axles. The valve gear used is Walschaert's applied to the outside cylinders, the valves of the inside cylinders being worked from the outside cylinder valve spindles through rocking levers at the front end of the valve chests. Superheated steam is used, the pressure being 175 pounds per square inch, and the superheat ranging from 630 degrees to 650 degrees. The boiler is of the Belpaire type, the mean diameter of the barrel being 5 feet ¾ inch and the length 14 feet 5⅞ inch. The firebox outside casing is 9 feet 6 inches long and the width 5 feet 7¾ inches at the top and 4 feet 1 inch at the lower part of the box between the engine frames. The total heating surface of all the tubes is 1,987.8 square feet, and the firebox heating surface is 161.2 square feet, with 30.5 square feet of grate area. The coupled wheels when new, with 3 inch thickness of tires, are 6 feet 9 inches diame-



Sir Gilbert Claughton. Six Coupled, Four Cylinder Passenger Engine.

ter. The front of the engine is carried on a four-wheeled radial truck, having wheels 3 feet 3 inches diameter. The weight of the engine in working order is nearly 78 tons, of which 59 tons are distributed on the coupled wheels, the maximum weight on one pair of wheels being about 20 tons. The tender carries 3,000 gallons of water and seven tons of coal, and weighs in working order about 39 tons. At the present time ten of these engines are in service.

A test run was made with one of these engines (Ralph Brocklebank, No. 1,159) between Euston and Crewe, on the 2d November last, with a train of empty main line coaches and the dynamometer car, the weight of which was 435 tons, and with engine and tender the total weight was 552 tons. The distance of 158 miles was covered in 159 minutes. This included three slacks and one stop, equal to about 6¾ minutes. The mean horsepower at the engine draw bar was 855. The average indicated horsepower taken at 25 points was 1,358 and the maximum was 1,617 horsepower. Besides the above mentioned class, 20 engines of the George V class, 16 of the Prince of Wales class, and 28 of the 0-8-0 freight engines, all fitted with superheaters, have been built.

With the electrification of parts of the London, Brighton and South Coast line, and the consequent acceleration of the passenger service, it became necessary to have more powerful steam engines to deal with the freight trains expeditiously. A special class of engine has been designed for this purpose and, second to the Stumpf experiment, it may be regarded as the most interesting locomotive production of the year. Designed by Mr. Billinton, the chief locomotive engineer of the above mentioned railway, the engine is of the Mogul type—i. e., having a leading pony truck with one pair of wheels, six-coupled driving wheels and no trailers. In addition to being a new type on this line, the engines have several interesting details. The Belpaire firebox appears for the first time on the Brighton line, instead of the ordinary round top crown which has been standard practice up to the present. The boilers are fitted with superheaters of 21 elements. The feed water, which is heated in the tender tank by exhaust steam, is drawn from near the upper surface, where it is hottest, by means of a float feed arrangement, and delivered to the boiler by a Weir pump which stands on the platform on the left hand side of the firebox. A No. 10 Gresham combination hot water injector is also fitted. The safety valves have an attachment by which blown off steam is turned into the tender tank instead of wasting its heat in the atmosphere. The slide valves are of the piston type, 10 inches diameter with internal admission, and operated by Stephenson link motion. The reversing shaft is provided with a clutch, operated by compressed air, in order to steady the motion and relieve the thrust on the reversing gear when the engine is working. The cylinders are fitted with a new type of combined vacuum and water relief valve. The piston rod metallic packing is enclosed in an air-cooled sleeve, and is of the non-floating type. Forced lubrication to the cylinders and piston valves is provided by a mechanical lubricator, which possesses the novel feature of being valveless. The weights are compensated between the pony truck and leading wheels, also between the driving and trailing wheels. The pony truck is center-pivoted, the weight being carried on two transverse laminated springs supported at the ends by heart-shaped links, which allow of the necessary side play on a plane parallel to the rail surface. Train heating apparatus is also fitted to the engine in case of its being used on passenger trains. The Westinghouse brake fittings are of the standard quick-acting type, with reservoir capacity for heavy service. The leading dimensions are as follows:

Cylinders	21 in. diameter by 26 in. stroke
Piston valves	10 in. diameter
Coupled wheels	5 ft. 6 in. diameter
Pony wheels	3 ft. 6 in. diameter
Rigid wheel base	15 ft. 6 in. diameter
Engine wheel base	23 ft. 9 in. diameter
Engine and tender base	47 ft. 11 in.
Length over buffers	57 ft. 5 in.
Center of boiler from rail	8 ft. 6 in.
Working pressure	170 lbs. per sq. in.
Heating surface—	
110 tubes, 2¼ in. diameter	790 sq. ft.
21 tubes, 5½ in. diameter	366 sq. ft.
Firebox	139 sq. ft.
Total	1,295 sq. ft.
Superheated tubes	279 sq. ft.
Total	1,574 sq. ft.
Grate area	24.8 sq. ft.
Maximum weight of engine in working order	63½ tons
Maximum weight of tender in working order	41½ tons

R. W. Urie, the chief mechanical engineer of the London and South-Western Railway, has been building ten mixed traffic engines of the 4-6-0 type, four with Robinson superheaters, four with Schmidt, and two using saturated steam. Some of the leading particulars are: outside cylinders, 21 in. by 28 in.; Walschaert valve gear; coupled wheels, 6 ft. diameter; tractive effort at 80 per cent boiler pressure 24,700 pounds. The heating surface with Schmidt superheater is 2,320 square feet, with Robinson superheater 2,254 square feet, and with no superheater 2,192 square feet. The grate area is 30 square feet and the working pressure is 180 pounds.

LARGE SECTIONAL FIREBOX.

The accompanying illustration shows the interior of the largest Jacobs-Shupert sectional firebox yet built. The photograph was taken during the process of construction, and before the back head and door sheet had been applied. There are twenty men seated about the table within the firebox. It is one of a lot of fireboxes being built for the Philadelphia & Reading to be applied to its I-8-A Consolidation locomotives. These locomotives are designed to burn anthracite coal, and hence the large grate area

Largest Jacobs-Shupert Firebox Built.

is required. These particular fireboxes will be equipped with the Gaines arch or bridge wall, so as to form a combustion chamber between the bridge wall and the back flue sheet. The firebox consists of fifteen channel shaped sections, each section being 10 inches wide over all. The firebox is 13 feet 2 inches long and 8 feet 8 inches wide, inside dimensions, and the distance from the bottom of the mud ring to the center of the crown on the inside is 5 feet 1 inch. It is expected that these fireboxes will be in service by next spring.

CONSERVATION OF NATURAL RESOURCES THROUGH THE ELECTRIFICATION OF RAILWAYS.*

By G. Percy Cole, Electrical Engineer, Canadian General Electric Co., Ltd., Toronto, Ont.

Reviewing the examples of the steam roads that have electrified their terminals and sections of their main lines, one is struck with the fact that few, if any, undertook the electrification from entirely an economic standpoint, and on account of the financial return expected on the money so expended. Municipal laws looking to the abatement of smoke have been largely the cause of past electrification. Up till recently, the consensus of opinion has been that such changes in motive power would, for some time to come, only be compelled by local conditions and ordinances, and that there were no inherent advantages in electrification to warrant its adoption under such conditions, other than the elimination of the smoke nuisance, and the ability of the electric locomotive to accomplish some special work not possible with the steam locomotive.

Recent developments in the art of applied electricity are gradually altering this state of affairs. A few years ago the discussions centered around the feasibility of heavy electric traction. The few important electrifications have shown results quite in accord with the calculations and estimates, and demonstrated conclusively that technically satisfactory operation of heavy railways by electricity is possible. The question then becomes an economic one. As approximately 70% of the revenue derived from the operation of railroads is obtained from the transportation of freight, we can understand why the managers of some of the Western roads are studying from the standpoint of economy alone, the application of the electric locomotive for main line operation over the mountain divisions. Economies effected on these divisions, where the cost is high, will have a large bearing on the total net revenue. Due to the advance in the art, we now find that propositions which, only a few years ago, could not be considered within the economic range for electrification, are highly attractive and commercially reasonable.

We hear a great deal nowadays about the conservation of our natural resources. It is only a few years ago that the mention of the word conservation simply resulted in a mental picture of somewhat vague, semi-official measures enacted to save our remaining forests from the ravages of the lumberman's axe. Now we save the forests by eliminating the spark-shedding locomotive! Thanks to the press of all civilized nations and the conservation commissions appointed in the various countries, the term "Conservation" has broadened very materially until now it embraces such subjects as utilization of water power, preserving the fertility of farm lands, assuring a continual supply of fur-bearing animals, the bettering of hygienic conditions of our cities, and other kindred subjects. To quote the words of Premier Borden:

"It means preservation, not waste; efficient development, not locking up these resources; the reasonable uses of them having regard to the nation's interests; and last, but not least, the participation by the people in all the advantages and benefits."

If our modern day civilization stands for anything, we must consider not only the material, but the labor side of conservation. It must be evident that the more efficient the operation of the country as a whole, the more rapidly must it add to its wealth and diminish the amount of labor which individuals have to expend in order to live at a certain standard. This efficient working of the country, to a large extent depends upon the proper use of its natural resources in the form of material and labor, and the elimination of all waste in both of these which can possibly be brought about.

If it is right for the nation, is it not also the duty of the individual to strive towards the more economical use of these resources, which it is only just to conserve for future generations? We must, however, not lose sight of the fact that "true engineering is based on economies."

Notwithstanding all our great hydro-electric power developments, a large part of our power supply is still obtained from the energy of coal. Look at the labor spent in and about raising and distributing the coal which we are now using up at such an alarming rate, and which we would save under more economical conditions.

Then there is the vast army of workers who are employed in cleaning up the dirt produced by our present methods of using coal. The daily routine of every household shows what a large proportion of domestic labor is devoted to this. There is also the enormous amount of labor of the people connected with actual operation of burning coal for all its various uses, which labor, under a more efficient system, could be turned to better account in the interests of the country.

We recently noticed in the papers, in connection with the discussion of the "smoke nuisance" in this metropolis, one of our Controllers was reported as stating that the pall of smoke hanging over the city and contributed by the large factories, railway locomotives and power houses, was a sign of the prosperity of the country; leading us to infer that the rate at which we can use coal is a measure of our industrial activity and prosperity. This would be true, perhaps, if we were using our coal with reasonable economy; but this is certainly not true of what we are at present doing.

Taking all the uses of coal into consideration, S. L. Ferranti has shown that we are getting back an amount represented by useful work of one kind and another, of much less than 10% of the latent energy in the coal. It is in the process of transformation of coal into work in the form of heat and power that this great loss occurs, as the process is a most difficult one, and requires the highest scientific and practical skill to carry out with even moderate economy. The fact that we are throwing away more than 90% of the value of our coal in the process of conversion is a matter of great concern to any nation.

Undoubtedly at the present time, the most convenient method of utilizing energy is by means of electricity. In the last few years remarkable progress has been made in the application of electric power in practically every industry; and the use of electrical appliances in our domestic life is also proceeding at a rapid pace. The question very naturally arises as to when and by what means will electrical energy be available in such large quantities and at such reasonable prices, that we can do away with all other forms of motive power and accomplish all our heating, lighting, cooking and other industrial applications solely by means of electricity.

Mr. Ferranti, above mentioned, one of the most noted authorities on prime movers in England, states that the only complete and final conversion of the whole of the coal which we use for heat and power into electricity, and the recovery of its by-products at a comparatively small number of great electricity producing stations. All our wants in the way of light, power, heat and chemical action would then be met by a supply of electricity distributed all over the country.

It must be remembered, however, that the distribution of energy in the form of electricity instead of coal can only be effectively carried out when it can be done in such a way that it is available for all the purposes for which coal is now used; and this can be the case only when the conversion is effected at such an economy as will cause the electric energy delivered, to represent a high percentage of the energy of the coal. Mr. Ferranti has shown that in order to supply electricity for all purposes, it would be necessary among other things, to have a conversion efficiency (efficiency of coal energy to electric energy) of not less than 25 per cent. On the basis of large generating stations of one-fourth million kilowatt capacity at the pit's mouth of the coal centers supplying net works of high tension transmission lines with a load factor of 60 per cent, he has estimated that the average price at which current could be supplied throughout the country would be one-fourth of a cent per kilowatt hour.

At the present time we are not able to purchase electricity for the above low figure, nor has the all-electric millennium yet ar-

* A paper before the Canadian Railway Club.

rived; but the central station generating industry has now grown to such proportions that in the large centers, power can be obtained at very low figures and on very satisfactory terms. In large blocks, it should not be difficult to purchase electrical energy at from ½ to ¾ of a cent per kilowatt hour. Recently the Great Falls Power Company has made a rate of 0.536 cents per kilowatt hour to the Chicago, Milwaukee & Puget Sound Railway, and agrees to construct some of the high tension lines, in addition.

If power can be obtained from the large central stations at such reasonable rates, it will not be justifiable for the steam roads, undertaking electrification, to go to the great expense of constructing their own power houses. In fact, considering the nature of the power load caused by through trains, whether freight or passenger, it will usually be impossible for the railway itself to manufacture its electricity at a cost of less than twice the price at which it can be sold to the railway at a profit, by existing electricity supply undertakings with large miscellaneous power and lighting loads.

The question may be asked: Would the addition of a large railway load be acceptable to the central station companies? This has been answered in the affirmative by Samuel Insull in a paper entitled "The Relation of Central Station Generation to Railway Electrification," read before the American Institute of Electrical Engineers, on April 5th, 1912. In this paper it was shown that the central station supply company will be able to provide the necessary electrical energy at an attractive price, for the reason that the annual consumption will usually be quite an addition to its lighting and miscellaneous power load, and for the further and important reason that the time distribution of the railway load will usually be such as slightly to improve the total load factor at the generating station.

In 1907, when this subject of electrification was being actively discussed by the large engineering societies, the conclusions arrived at seemed to be such that, at the then present state of the art, the steam roads were not justified in undertaking the large capital expenditures involved in building their own power stations, even though, by adopting electricity for their motive power, numerous economies would result.

At that time, compared with the then existing conditions, the magnitude of the power load required by railways appeared large. For example, the kilowatt capacity of the power houses for the New York Central electrification amounted to 20,000 kilowatts. To insure continuity of service, duplicate power houses were resorted to, thus doubling up on the capital expenditure for this portion of the electrification. The capital costs of these power houses amounted to approximately $3,500,000.00, which figures out at a little less than $90.00 per kilowatt; and certainly no one blames the heads of the steam roads for steering clear of electrification in the face of such tremendous capital outlays.

The intervening years since 1907 have completely reversed the situation. The independent central stations of the large centers have grown at such a pace that their capacities in some instances now run up to the hundreds of thousands of kilowatts with individual generating units of even 35,000 K. W. capacity; thus making the power required for a division of a main line railway seem, in comparison, extremely small. In the United States, and to some extent in Canada, the transmission net-works of these large central stations are so extensive, that it is only a question of a few years until practically the whole country, at least in the more populous districts, will be entirely covered, with the result that large blocks of power can be supplied to the railways from these net-works, at very attractive figures, and that on account of the non-coincidence of the railway and lighting load peaks, the railway load will be a desirable addition; even granting that the load will be more or less fluctuating, as would be the case on a division with relatively few trains per day.

In whatever form energy is produced and distributed to the train, it ultimately appears as mechanical energy applied to turn one or more axles against the resistance to their rotation imposed by the weight on the wheels and the motion of the train. It is instructive to examine and compare the over-all efficiency from coal pile to driving wheels for electric and steam operation. Taking first the conversion efficiencies for electric generating stations, we find the following:—

Electric generators driven by reciprocating steam engines, their economy expressed in the form of energy in the coal to electric energy, may be taken as a maximum of 10 to 12 per cent. Steam turbine driven generators, a maximum efficiency of 17 per cent. Next in order of economy comes the large gas engine fed from gas producers, with an efficiency of coal energy to electric energy of possibly 25 per cent. Finally we come to the internal combustion engine using crude petroleum (Diesel type) direct connected to electric generator, and we find the maximum efficiency of fuel energy to electric energy to be in the neighborhood of 30 to 31½ per cent.

The above figures all apply to the largest power stations at present in existence and the efficiency is the "power" efficiency of the station at full load and unity power factor. These figures will be very much reduced when we consider the annual overall efficiency from the fuel to the outgoing cables or as it is termed, "energy" efficiency. This latter efficiency takes account of the load factor of the station, or all the varying conditions of output during the 8766 hours of a year. Take for example the steam turbine station. During the short periods of maximum load, the efficiency of the station may be from 15 to 17 per cent, but high values of this sort are offset by very low values of 3 to 4 per cent, occurring during times of very light load. If we can get an annual overall efficiency of 11 per cent, we are doing very well indeed. For the other types of prime movers, we get a correspondingly reduced annual overall efficiency, as the following table will show:—

	Power Efficiency of Station at Full load.	Annual Overall Efficiency of Station.
Reciprocating Steam Engine Station	10-12 %	8%
Steam Turbine Station	15-17 %	11%
Gas Producer and Gas Engine Station	25 %	18%
Diesel Engine Station	30-31½%	22%

But if the cost of manufacturing electricity is analyzed in detail, it will be found that for station of large outputs we can eliminate all except the steam turbine station. If the analysis is made according to the latest approved methods, by dividing the total cost into (1) Production of costs; (2) Investment costs; (3) Administration costs, it will be found that the cost of manufacture by means of steam turbine stations is much less than with the three other types of prime movers, even with coal costing $4.50 per ton of 2,000 lbs., which is rather a high figure. Contrasting the steam turbine station with the internal combustion station, H. M. Hobart has shown that even with the 22 per cent annual efficiency of the latter plant, the total cost of manufacturing energy is 13 per cent greater than in the case of steam turbine 11 per cent efficiency plant, for two reasons. First, the oil fuel with a calorific value of 18,000 B. t. u. per lb., and costing 4 cents per U. S. gallon, costs twice as much per kilowatt hour of calorific value as the $4.50 per ton coal with 14,500 B.t.u. per lb. If the coal had cost only $2.25 per ton (and good coal is obtained at this price in many stations) then the oil would have cost "four times" as much as the coal per kilowatt hour of calorific value; and even if the oil engine station have had 44 per cent overall efficiency, the fuel cost per kilowatt hour of output would have been as great as in the 11 per cent efficiency steam turbine station.

Let us now investigate of what order of magnitude the efficiency becomes when delivered to the driving wheels of the locomotive after all the losses due to transmission, sub-station transformation, low tension feeders and locomotive motor equipment are taken into account. Assuming a steam turbine station with 11 per cent annual efficiency, it can be shown that the overall efficiency from the coal pile in the power house, to the rims of the drivers, is, for practically any well designed and commercially sound railway scheme, of the order of 6.0 to 6.5 per cent. In this connection two

noteworthy papers have been presented recently before the American Institute of Electrical Engineers. The first by H. M. Hobart, entitled "2,400 Volt Railway Electrification" (A. I. E. E. proceedings, p. 1,017, May 20, 1913). The second by Chas. P. Kahler, entitled "Trunk Line Electrification" (A. I. E. E. proceedings, p. 1,057, May 20, 1913).

In the first paper, taking an example of a 75 ton electric locomotive hauling 10 Pullman coaches weighing 75 tons each, and making a non-stop run of 100 miles in two hours, Hobart has calculated the annual overall efficiency from coal pile to driving wheels to be 6.1 per cent for dense service and 6.6 per cent for sparse service. Comparing with this a 185 ton Pacific type steam locomotive hauling the same train over the same distance at the same schedule speed, he finds the net efficiency from the coal to the drawbar of approximately 2.65 per cent, thus showing that the electric locomotive requires only 47 per cent of the amount of coal which is required in the case where the same train of 10 Pullman coaches is hauled by a steam locomotive. If this is expressed on the basis of coal consumption per ton mile of "useful" load (i. e. per ton mile behind the drawbar) we have:

For the steam train 0.163 lb. of coal per ton mile.

For the electric train 0.077 lb. of coal per ton mile.

But we read in Bulletin 402, published by the U. S. Geological Survey, entitled "The Utilization of Fuel in Locomotive Practice," by Dr. W. F. M. Goss, as follows:—

"Observations on several important railroads have indicated that not less than 20 per cent of the total fuel supplied to locomotives performs no function in moving trains forward. This amount is dependent only to a very slight extent on the characteristics of the locomotive, being in a large measure controlled by operating conditions, the length of divisions and the promptness with which trains are moved."

There are other ways in which the fuel can be wasted. For example, the fuel lost by dropping through the grates is a factor that depends on the grate design, and on the characteristics of the fuel, but chiefly on the degree of care exercised in managing the fire. A familiar sight, when walking along the ties of some roads (where they don't pinch you for trespassing) is the amount of coal near the track and on the embankment, that has jiggled off the tenders of passing locomotives; to say nothing of the lumps of coal used by the firemen as ammunition against barking dogs and other animals. Other considerations involved are: the cost of the coal delivered at the convenient site of the generating station is materially less than the cost of the same coal by the time it is loaded on the locomotive tenders, and also, a cheaper grade of lignite coal can economically be employed in a generating station than on steam locomotives which are usually supplied with run of mine. Thus, if the comparison were carried beyond the quantity of coal per train mile and reduced to terms of the fuel cost per train mile, the result would in most instances be to increase the above 2 to 1 ratio (2 for the steam locomotive to 1 for the electric locomotive) to a ratio more of the order of 3 to 1.

If the traffic of the country could be moved with only ⅓ of the amount of fuel it now takes to move it, enormous quantities of coal would be conserved for future generations. Let us get some idea of the amount and value. In 1911 the total amount of bituminous and anthracite coal mined in the United States was approximately 535,771,000 short tons. For the same year in Canada, 11,323,000 tons were mined, or a total of roughly 547,000,000 tons for the two countries.

It is estimated that locomotives use more than one-fifth of the total quantity of coal mined. On this basis, we have the annual consumption of coal by locomotives in Canada and the United States amounting to approximately 110,000,000 tons. If it were possible to save ⅔ of this, valued at $2.00 per ton, we effect a yearly saving of roughly $147,000,000, which amount would go a long way towards paying the interest on capital expenditures for electrification.

But there is not going to be wholesale electrification that will result in any such economies during the next few years. To believe that we are face to face with such a saving would be on a par with believing that, because the Mallet locomotive used in the St. Louis tests developed under certain conditions a drawbar horse-power hour form 2.6 lb. of coal and that by the addition of superheaters, this figure could be reduced to approximately 1.6, we are then justified in assuming that the aggregate coal consumption of steam locomotives can be obtained by multiplying 1.6 lbs. by the aggregate drawbar horse-power hours required to operate the existing freight and passenger service of the country. In America, there is no evidence that the heads of our steam roads are contemplating any general electrification in the near future; for it is obvious that in these days of railroad regulation and difficult railway finance, unless we have a definite answer to the question, "Will it pay?" very little progress can be made. But it is right at this point, however, that it is necessary to consider the subject in its very broadest aspects. In no line of human endeavor is there such building for the future as in railroading. Otherwise we would not be witnessing the present increased activity in the application of the electric locomotive to steam railroad properties. If in the past, the electric locomotive has made inroads into the steam field, in connection with tunnels, terminals and mountain grades, it has been because it was the logical machine to adopt. The saving may not be apparent in lower operating costs, but may result from greatly increased capacity, the elimination of water stations along the line, the reduced steaming capacity of the steam locomotive in very cold weather, just at the time it requires its maximum power, the increased speed of trains over single track mountain divisions, the improvement in conditions of travel due to the elimination of all smoke, the many incidental advantages in having electric power available at all points of the system, and in many other different ways that will suggest themselves to the seasoned railroad man. The point that it is desired to bring out here, is that the interest in the electrification of railways is fully justified, and that each case should be considered on its merits. For many years to come, for trunk line service, the steam locomotive will be used; but in building for the future, it will be wise to thoroughly investigate electric operation. We all know that in years gone by, many trolley lines have been built much in advance of their commercial justification; but the result has been a tremendous aid to the rapid extension and development of the communities served by these lines.

The American Institute papers of Messrs. Hobart and Kahler previously referred to, and also a paper by A. H. Babcock, electrical engineer of the Southern Pacific Co., merit the perusal of all thoughtful railway men; for in these papers, we have the optimistic and pessimistic sides of railway electrification discussed at great length by world-wide experts. To show that engineers now realize to the full that electrification will be a very gradual process, the following extract from Mr. Hobart's paper is of interest:—

"The predominating item in the capital outlay is that for rolling stock; and against this outlay a credit can equitably be allowed, since the replaced steam equipment can be used up on non-electrified divisions. In other words, in making up its budget for new rolling stock, a railway engaged in electrifying its system by divisions, will in each successive year devote a greater sum to the purchase of electrically equipped rolling stock, and a lesser sum to the purchase of equipment for steam operation."

Leaving aside the economic feature, there are several important reasons why we have not seen electric operation more generally adopted on steam lines. In the writer's opinion, the foremost reason is the fact that in the modern steam locomotive we have a mighty good thing. On the whole, it is very reliable, and in what business is greater reliability required than in railroading? Everyone knows it is pretty nearly as difficult to change a Canon of the Church as to introduce some new feature on railroad rolling stock. The attitude is reasonable, and

natural; as the responsibilities involved in any radical change are very great indeed.

Another reason is the fact that for the last few years there has been a discussion going on in the various engineering societies as to the best system to use; leading outsiders to believe that there has been a much greater lack of agreement in regard to systems and standards than is really the case. However, as the economic range of application of each system is becoming better known, we are now emerging from the chaos of five years ago to a clearer understanding of the relative merits of each system. The actual operating results from existing terminal installations has been a large factor in clearing up debatable points.

Choice of System.

As in steam operation, there is no universal locomotive that is used for freight, passenger or shunting service, so in electric operation there is no one system that meets all the varied demands of railroad operation. Experiments are being carried out on both sides of the water with systems, employing mercury arc rectifiers, split phase converters, special forms of single phase motors, etc.; and while many of these systems show great promise, they are still in the experimental stage, and we will thus consider only the four systems furnished by the present state of the art, as follows:—

1. The low pressure direct current (D.C.) system, working at 500 to 600 volts.
2. The high pressure (D.C.) system working at 1,200 to 3,000 volts.
3. The single phase alternating system.
4. The polyphase (3-phase) alternating system.

System 1 has abundantly proved its applicability for electric urban traction and short urban or interurban railway lines all over the world. The low voltage employed limits the economical use to a few miles, unless coupled with the employment of rotary converter substations. In this latter case, the energy is transmitted by three-phase alternating current at high voltage to transformer stations along the line, and there changed to D.C. current at 500-600 volts.

System 4, the three-phase system, finds its greatest application for mountain grade divisions and tunnels with heavy grades; as it is possible to introduce great economies in operation, due to being able to connect the motors as generators and return power to the line when going down grade. The Great Northern Power Company has adopted this system, and its success and the success of the Valtelina line and several other similar north Italian lines, has encouraged an extension; and a Parliamentary appropriation of twelve million pounds sterling has been made for electrification of Italian main line railways on the three-phase system. The greater complications of the overhead line, involving a double trolley wire and those of the arrangements for speed regulations have been arguments against the three-phase system.

System 2, the high pressure D.C. system, while the last to enter the field, is in the opinion of many, the solution for trunk line electrification. It is now well known that the Lancashire and Yorkshire Railway Company is going to electrify a short length of line between Bury and Holcombe Brook at 3,000 volts D.C. It is not anticipated that the consumption of current at the train will be in any way different from that of any other continuous current train, but it is certain that the capital cost of rolling stock will not be appreciably greater than that of the low tension continuous current rolling stock, and that a very high efficiency of transmission will be obtained between the power station and the train.

System 3, the single-phase alternating system, has now been tried out for a number of years. In this system, single-phase traction motors having commutators called respectively compensated series and compensated repulsion motors, have been invented, and these can be accelerated and reversed with the same ease as continuous current motors. The A.C. motors are about half as large again as the D.C. for the same power output, the switching arrangements are heavier, and the motor has generally to be associated with a transformer; but the advantage of being able to transmit and pick up current from overhead trolley wire at high voltage and transform down on the locomotive to low voltage is very great.

The future of railway electrification at the present time seems to lie between the single phase alternating, and the high pressure direct current systems for main line work. The nature of the current affects the system of operation, and it is much easier to obtain the power necessary to drive motor car trains of varying make up with direct current than with single phase alternating current. The horse power output per ton of electrical equipment has been estimated at 11 H.P. for D.C., as against 6 H.P. for A.C. motors. The operating costs for A.C. system are certainly higher than for D.C. Mr. J. Dalziel, in discussing a paper presented before the Institution of Electrical Engineers, states, "While the single phase system has certain drawbacks in increased weight and cost of rolling stock equipment, on the one hand, possible main line electrification cannot with prudence be overlooked, especially on some lines; and on the other hand, even in dense urban passenger traffic work, its disadvantages are by no means so outstanding, and it in fact has advantages of comparative performance sufficiently great to make its rejection for any work that may be in contemplation a matter for the gravest consideration, and, indeed, of bad engineering where main line work is possible."

In America, however, in the opinion of the writer, the high tension D.C. system has a preponderating advantage in that without much difficulty, power can be obtained from existing large stations whether equipped with 60 or 25 cycle generators. The single phase system requires 25 cycles or lower; in schemes of magnitude, 15 is figured. This precludes the single phase A.C. system from obtaining power from any of the existing supply companies, without interposing expensive frequency changer substations, thus taking away the main excuse for adopting the single phase system; namely, the use of simple booths equipped with transformers instead of substations containing rotative machinery.

The main essential is to thoroughly realize the limitations of each system, and act accordingly. Each electric system has its own particular field, and steam also has its field. The high voltage D. C. system is not the panacea for all electrification. Hobart says: "It is possible that the single-phase system may play an important part in certain classes of railway work, such as for hauling freight trains and express passenger trains; but in the interests of railway electrification, it is important to confine the application of the single-phase system to its true economic range of work; or, at any rate, to classes of work not widely outside of this range."

A method that has been recently adopted, where electrification is under consideration, is for the railway to obtain alternate tenders from firms of repute who are capable of carrying out both systems equally well, not only for the first cost of the installation, but also for the cost of operation. This method has been recently followed by the Commissioners of the Victorian Railways, for the very large electrification scheme in the vicinity of Melbourne. Tenders and guarantees were obtained from all the chief manufacturers of the world, and a decision reached only after very careful deliberation. The Melbourne electrification is on a large scale, and is the first instance where the decision has been made after a consideration of electrical as compared with steam locomotive methods.

The writer is aware of the wonderful developments that have taken place during the last few years in the design and improvement of the steam locomotive; where we now have large articulated compound engines capable of exerting drawbar pulls of over 100,000 lbs., working simple, and that it is claimed by the use of superheat, the consumption of coal per horse power hour at the drawbar is now only about 2¾ pounds. It is safe to assume, however, that by the time the electric locomotive has behind it the years of development now pos-

sessed by the steam locomotive, considerable electrification will have taken place. One of the biggest factors in bringing this about on this continent is the fact, that, in spite of all the muck raking magazine articles, it has been abundantly proved that the railroads of this country are not over-capitalized and that, on the contrary, they are very much in need of money and added capitalization. In comparison with English railways, it has been shown that the American roads with only one-fifth the capitalization per mile, handle one-fourth more business, charge only one-third the rate, pay double the wages, and are supported by only one-seventh of the population. Is it not safe to assume that some of the added capitalization will go towards electrification, after its economies have been fully proven? The present capitalization of English railways is very much higher than in this country. This is undoubtedly holding back electrification to some extent, as the directors of the roads are extremely reluctant to add anything to their present burden of fixed charges.

The large water powers with which this country is endowed should aid in electrification, since large quantities of cheap energy are available in various parts of the country.

Indirect Advantages from Electrification.

Only one or two of the indirect advantages accruing from electrification will be mentioned here. If the railroad purchases large blocks of power at low figures from the central station supply companies at the large centers, it will be able to utilize a portion of this energy for operation of its railroad shops.

As the high tension transmission lines will in all probability travel along the right-of-way of the railroad, taps can be taken off from the lines and power sold to advantage to small towns or large farms and ranches. Inexpensive stepdown apparatus has lately been developed, enabling even small quantities of power to be tapped off high voltage lines. In the great wheat belts of Canada, the power could be sold to do the threshing and perhaps in the future, to increase the yield per acre, due to the direct stimulation of plant growth by means of electricity. Experiments in England have shown an increase in the yield per acre of from 15 to 50 per cent, due to a proper application of high tension currents. In California it has also been shown that an electrified field in which sheep are grazing, has largely increased the yield of wool and improved the quality at the same time.

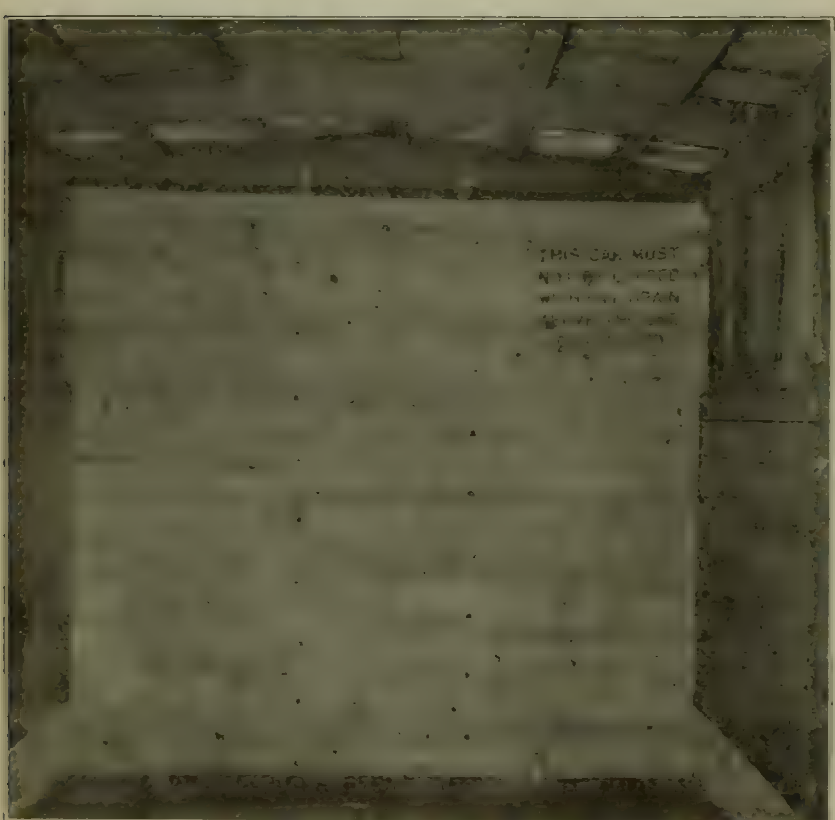
The adoption of electricity as a motive power for all manufacturing operations would mean an immense conservation of the labor of the nation. This would have a tendency to make labor more remunerative, which in turn would stimulate invention in all kinds of labor-saving devices; in other words, electrical appliances; and thus the all-electric millennium would be well on its way. In fact, the signs of the times are not wanting at the present moment; for just recently there has been formed the "Society for Electrical Development, Inc." The official slogan of this society is, "Do it electrically," and the spontaneous support received from every branch of the industry means an immense stimulus during the next few years. It behooves us all therefore to be in a receptive mood.

REINFORCING WOODEN BOX CARS.

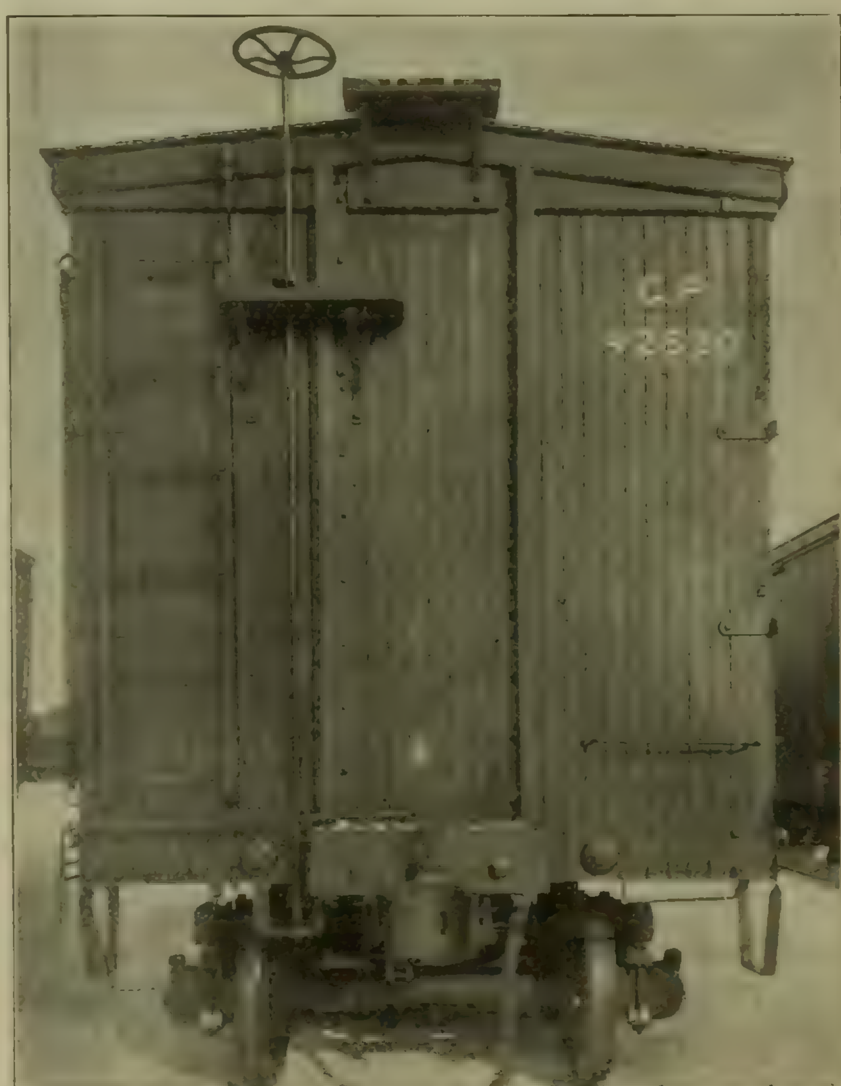
In an effort to strengthen the ends and draft sills of the 30 and 40 ton wooden cars, the Canadian Pacific Railway has added inexpensive reinforcements with most satisfactory results. Defective draft sills are replaced with 6-inch 22.7 steel Z bar sills. Three-inch 6.7 Z bars are bolted to the end posts, extending to the bottom of the end sill behind the deadwood and bolted to the end sill. Inch and three-quarter lining is applied to cover the original lining, being secured with the end post bolts as well as being nailed to the intermediate end posts and corner posts.

The Z bar center sills have given the most satisfactory results. They are very easily applied to the car, and there is no additional delay on the repair tracks to equip the old cars with the steel sills. The steel sills are riveted to the body bolsters, bolted to the needle beams and securely attached to the end sill, the end sill being supported by the reinforced end.

In the application of the 1¾-inch lining over the original lining the cost of repairs to the original lining is saved, making the addition of the heavy lining cost but very little. The Z bars bolted to the outside of the old end posts are also an inexpensive improvement as they can be applied over cracked posts.



C. P. Wooden Box Car Showng Reinforcing Lining. Note Bolts Which Extend Through Lining and Outside Z Bars.



C. P. Wooden Box Car Showing Z Bar Reinforcement at End.

Freight Train Handling*

Draft rigging in fair to good condition is not pushed in nor pulled out. It is either driven in or jerked out, both implying a severe blow. The severity cannot be judged by any shock felt by those riding trains, particularly the engineer of a heavy locomotive. For a shock to be felt the speed must change suddenly and considerably. The amount of the instant reduction in speed of a modern freight locomotive that is necessary to cause a break-in-two is too little to be felt as the severe shock that it is to draft rigging. Engineers who do not understand this are prone to attribute resulting failures to the condition of the draft rigging instead of to their handling.

A train composed of empties behind loads is not an excuse for breaking-in-two; neither, as a rule, is an "old defect." Many of such defects should be called ancient, as not infrequently they are original in old couplers. While allowance will be made for an old defect, yet the fact that its evident age did not result in failure before, asks whether it would have occurred then with proper handling; or, if the draft rigging was plainly defective, why it had not been noted in season and the car switched to the rear, or, if necessary, set out? Every "old defect" not original with the part that failed was once a new defect, and the man who breaks many of the "old defects" is one who is contributing to the new ones. Therefore, this bald statement cannot alone be accepted as a sufficient explanation.

The secret of smooth train handling lies in ability to control the slack, in preventing it from running in or out harshly. Where so controlled no draft gear in fair to good condition will be damaged. Slack action cannot be prevented, but by engineers acquiring knowledge of the various causes for it and exercising forethought in the use of steam, train brakes, independent engine brakes and sand, it can generally be controlled, even to the extent of avoiding further injury to damaged draft gear. The heavier the locomotive and the longer the train the greater is the care required. In train handling harsh running out of slack is the usual trouble, proven by about 40% of the break-in-twos occurring within ten cars of the engine. Slack is run out by the use of steam as well as brakes.

Comparative records of engineers and conductors in the same class of service, where all must at times have trains requiring more than usual cars to avoid draft gear damage, prove that much of the damage which some experience can be avoided. To effect and maintain an improvement the co-operation of all concerned, including switchmen and car men, is requested. Intelligent observance of the following will aid greatly.

Instructions for Freight Engineers.

Slack cannot be changed both gently and quickly; therefore, "make haste slowly" is imperative when steam, grade or brake action is changing the slack, either stopping or starting trains. That is, where any one of these is changing the slack allow ample time for the change to be completed before doing anything that would hasten it. Also, do not endeavor to start until the gage indicates sufficient brake pipe pressure to give reasonable assurance that all brakes are released.

As one illustration, when releasing the train brakes while running, do not commence to use steam until certain the slack has had ample time to run out, and even then start its use gradually. Another is where, when running forward, steam is shut off and brakes applied; allow ample time for the slack to run in before applying the brakes. Even then make a slight reduction if the speed is low. The following is an example of insufficient time and results: Where a long train has just been started, and while the engine is working heavily, if steam is shut off suddenly and a heavy service application is made at once there is liability of driving in couplers or even of "jackknifing" any weak car near or ahead of the middle of the train.

There are two kinds of slack, loose slack and spring slack. They work together. Loose slack is that which can be run in or out without compressing the draft gear springs. It merely permits of shocks. Spring slack is the additional amount that can be had, in or out, when these springs are compressed, and which helps to drive the slack in the oposite direction and thereby increase the shocks. The first of the following illustrations gives an example of this draft gear spring action. These springs are compressed with slack either in or out heavily, and at such times their action must be considered as well as that of steam, the brakes or the track.

With no slack and good draft rigging trains could not be broken in two. The same can be said with slack either all in or all out and held so. The damage arises from its sudden change. When slack runs in or out rapidly one part of the train gradually attains a lower speed than the other and the shock is the result of the draft rigging having to suddenly make the speed uniform on the instant the slack is all in or out. How heavy the shock will be depends mainly on the difference in speed that must instantly be made uniform and on the weight that must suddenly be altered in speed. Weight is important, as with a heavy locomotive or loaded cars, but change in speed is more so as changing it suddenly 3 m.p.h. will cause nine times the shock than will a similar quick change of one m.p.h.

To illustrate, suppose that on an ascending grade, steep enough to alone start the cars back, a long train was stopped with the engine brakes only, fully applied as the speed became low and held on after stopping. The compressed draft gear springs would help the grade to start the rear and back and when all slack had run out, the rear half of the train could easily be moving at three or four miles per hour. If the engine brakes could be released on the instant all slack had run out the jerk necessary to instantly bring the standing engine to three or four miles per hour would be more than draft rigging could stand, yet it would be worse if the engine brakes were applied.

Had the engine braking power been gradually reduced as speed became low and entirely released shortly before the stop was completed the compressed draft gear springs would have gradually run out the slack. Then the grade would have started the entire train back with little or no slack action and a light application of either the train or the engine brakes would have stopped it without damage.

Again, assume a long train, having empties behind loads, being stopped with the train brakes, on a level grade and from 25 m.p.h.; that the first reduction and leakage had reduced the speed to 6 m.p.h.; that at this time, when the brakes on the empties had the slack pulled out heavily, a further reduction of, say, 7 pounds, were made. The head brakes would feel it first and start the slack in. Just as this would stop the loads from pulling on the empties, the latter would feel the reduction. At low speed brake shoe friction is high. Hence, the empties would "anchor," and by the time they had run out the slack the majority of the train would be three or four miles per hour lower in speed than the engine, meaning that the latter must instantly be reduced in speed that much. Draft rigging could not stand this and a break-in-two would follow.

Had no reduction been made at 6 m.p.h. the slack would not have changed except to draw out a little more. It could not run out, as the only additional possible would require more compression of the draft gear springs. These are compressed with slack pulled out as well as when it is pushed in. Hence, there could be no bad jerk, merely a hard pull and, possibly, a light jerk. But even this would be avoided if, when within 40 feet of stopped, an additional reduction of 6 or 7 lbs. were made. The forward brakes would feel it first and would start the slack in, but the train would be stopped before the rear brakes could respond to this reduction and run the slack out again.

Yet another illustration: assume the same train being backed at low speed, engine working heavily, draft gear springs thereby

*Read by F. B. Farmer, of the Westinghouse Air Brake Co., at the January meeting of the Western Railway Club.

compressed; then, that steam were shut off and, say, a service reduction of 8 lbs. were made. The brakes on and near the engine would feel it first and start the slack out, the coupler spring would help to run it out faster and by the time it was all out there would be a similar difference of 3 or 4 m.p.h. in speed between the ends of the train. While the shock would be severe, possibly enough to cause damage, it would be less than with the loads at the rear end, and even then much below that in the fore part of the previous illustration, because of the lesser weight to be suddenly reduced in speed.

If, when backing, steam had been used somewhat lighter at first, then heavier from the time the brake application was begun, the reduction had been but 6 lbs., and if the engine had been prevented from applying, no serious shock would have occurred at the rear end because the lighter reduction would have had less effect, and the heavier use of steam then and preventing the engine brakes from applying would have largely offset the effect of the earlier response of the head than of the rear brakes.

With sufficient tie another method would produce equally good results. That is, shutting off steam, waiting for the compressed coupler springs to drift out the slack, applying the engine brakes lightly to stretch it farther, then making the reduction of 6 lbs. and at the same time releasing the engine brakes. However, this would take more time than is generally had, is more complicated, and, therefore, the other method is better.

The foregoing illustrations of the wrong and the right methods are to demonstrate that the main cause for damaging shocks in train handling is slack action, and that it can be controlled. While showing that the use of steam can help to prevent harsh slack action, by opposing the tendency of the brake action to change it, it is plain that if used in the same direction as the brakes tend to run it, the slack will be increased. Bear in mind, though, that if the slack is either in or out heavily any brake action that tends to run it in the same direction cannot cause any severe shock; therefore, that, when running ahead, slack in is generally more favorable for applying, as slack out is for releasing. While it would make the instructions too long to cover every condition of train, or brakes, of track, speed, etc., by illustrations and specific directions, the foregoing and the following instructions will almost invariably enable any engineer, who has the knowledge he is supposed to and who exercises judgment and forethought, to avoid damaging shocks from slack action.

Undesired quick action or ''brakes dynamiting'' can be caused, especially with long trains, by a very light (3 or 4 lbs.) or very slow reduction (lapping the brake valve and allowing brakes to leak on), where it would be avoided by braking as directed. Therefore, avoid these two bad practices. If it cannot be avoided the shock will be less where the speed is higher, but the faulty triple valve should be located, cut out and carded. In starting a freight train keep the engine at a slow and uniform speed for two car-lengths, and don't vary this rule because less distance may have started the entire train.

In slacking to start a train, endeavor to take either a foot or two or the slack of the entire train. Take but little if slacking the entire train will allow the rear end to run back, as an attempt to take all then will almost certainly cause damage. With a helper at the rear any slacking should be done carefully by the helper engineer, the head engineer keeping the throttle open moderately, but prepared to temporarily ease off enough to prevent a lunge when he is started. With two engines ahead the second engineer should allow the head one to start the train, or, if impossible, to almost stall before aiding him. Starting together will cause a severe shock if any slack is in.

Excessive slipping of drivers causes severe shocks to draft rigging. The coupler springs cause the slack to change quickly, and this is usually followed by a severe shock with the renewed use of steam. Hence, when slipping is probable, use sand. Also, when working an engine heavily at slow speed use no more throttle than necessary. Full power is then obtained with a moderate opening. The beginning of slipping will instantly reduce the steam pressure in the cylinders, and, with the quick and slight closing of the throttle then possible, will at once ''steady'' the engine without much change of slack or loss of speed. With two or more engines in a train, excessive slipping of one will often cause the other or others to slip.

How rapidly any certain brake action, either application or release, may change the slack depends on the speed, because brake shoe friction, the actual holding power, is higher, with the same application, as speed is lower. This is why the slower-releasing rear brakes are liable to cause a break-in-two on attempting to release at low speed, particularly if the reduction is heavy, yet will not produce any appreciable shock when release is made at the higher speeds. Therefore, it follows that the lighter the reduction at any certain speed the less will be the slack action. The higher the speed or the lighter the application the less will be the slack action from either applying or releasing.

Attempt no ''spot'' stops. This means do not endeavor to run up close to a switch to head in, and to always stop short and cut off for coal and water. The main object is to stop properly within any reasonable distance short of the switch, the water tank or coal chute. Proper stops can not be made regularly, and, at the same time, stop the engine at some desired spot. Trying to stop close to the switch or to spot for coal or water without cutting off causes the trainmen more work, by draft gear damage that occasionally results, and injures the reputation of an engineman.

Shut off steam gradually and allow ample time for the engine to drift in the slack as much as it will before commencing to apply the brakes. With a drifting throttle use no more steam than necessary and none below 7 or 8 m.p.h. If set when at normal speed and not changed, the engine will be working hard when speed is low.

At ordinary speed make each stop with one application but with two reductions. Make the first reduction sufficient and at a point to insure that it alone will, with no additional reduction, prevent the engine from passing the objective point. Take all chance of error in judgment on the side of stopping too soon. Then, when not over 40 feet from stopped, make the second reduction of 6 or 7 lbs. The only object of this second and final reduction is to start the slack in at a time too late for it to run out again before the stop is completed, thereby reducing possible strains on the draft rigging and bunching the slack more or less for starting. It must not be made earlier than directed as to do so is liable to cause a break-in-two rather than prevent one. When made properly the brake valve will be discharging when the engine stops. If the grade permits, release may be commenced as soon as the train is stopped and without waiting for the brake valve discharge to cease.

The heavy use of sand for the last eight or ten car-lengths will increase the holding power of the head brakes and will reduce liability of driving wheels sliding. Releasing the locomotive brakes or reducing their holding power at this time increases liability of damage to draft rigging and should be avoided if possible.

If the slack stayed in after the first reduction no harm would result from making more reductions between it and the final one, but the engineer cannot know how the slack will be with any train other than one with empties behind loads. With the latter the slack is sure to stretch after each reduction but the one made within 40 feet of stopped, and this may be true of any other make-up. With slack out each reduction starts it in and is followed by it running out. The slower the speed and the greater the reduction the heavier will be the run-in and the following run-out; hence, the worse the jerk.

The amount of initial reduction should suit the speed of the train and the grade, and must not be less than 6 lbs. nor over 12 lbs. For speeds of 15 m.p.h. and less use a 6 to 8 lbs. Above 15 m.p.h. use as much less than 12 lbs. as conditions will warrant. The objects sought are to have all slack action take place at the higher speeds, so as to insure that it will be gradual, at the same time to permit it to adjust itself however it will, and then not to

disturb it any by further reductions until the final one; also, to avoid a total reduction of over 20 lbs. if practicable.

An exception to the rule of one application for stopping a freight train is where speed is very high, particularly where the stopping place is a meeting point or a railway crossing; in fact, any place where additional hazard would follow lack of entire control. Under such conditions a reduction of about 12 pounds should be made far enough from the objective point to permit of slowing the speed to between 20 and 25 m.p.h., not lower than 20 and of releasing and recharging quite thoroughly before reaching the place where the regular application for stopping should be begun.

When stopping a long train while backing at moderate or low speed use a light reduction, keep the engine brakes from applying and continue to use steam. The object is to prevent the slack from running out harshly.

Speaking generally, all stops should be made with the train brakes, experience having demonstrated that rough work too frequently accompanies stopping with the independent engine brakes because the power of these brakes on a modern freight locomotive and the time necessary to run the slack in or out gently are neither not appreciated or the knowledge is not used.

The presence of "K" triple valve will not permit of releasing long trains at low speeds unless the forward 25 cars have these valves and cut in. The holding power that can be retained on the engine will not alone permit of this. It is a help, but has its limitations and which are far below that of 25 "K" triple valves.

At how low speeds brakes can be released without liability of damage depends on how heavily they are then applied, the amount of main reservoir pressure, the length of the train, whether slack is then in or out, lightly or heavily, and on whether track conditions (sags, humps and curves) do or do not favor releasing. Plainly, no simple rule can care for these varying conditions.

Where reasonably efficient retaining valves are in use, it is practicable to release at somewhat lower speeds than when they are cut out—handles down. While the head brakes always start to release before the rear ones the retaining valves cause a much slower fall of brake cylinder pressure than when they are not in use and this causes the slack to run out more gradually.

The most favorable conditions for releasing brakes are train standing, maximum main reservoir pressure and brakes almost fully applied. The most difficult release is when the brake pipe pressure is very low, as where the engine has been cut off for some time, after a burst hose, a break-in-two or emergency application, because of the large amount of air required to raise the pressure in the brake pipe, also in the auxiliary reservoirs of all early releasing brakes, above the pressure in the auxiliary reservoirs of the best holding brakes, particularly those at the rear. Next in difficulty of releasing is after a light application from standard pressure. The high amount remaining on each triple slide valve makes it harder to move to release, and the lesser difference between the brake pipe and the main reservoir pressures causes a more gradual flow into the brake pipe, and, consequently, a slower rise in its pressure. To insure release a quick and considerable rise of brake pipe above auxiliary reservoir pressure must be had. Furthermore, in trying to get this to the rear after a light application the head brakes are sure to be so heavily over-charged, above the adjustment of the feed valve, as to insure that some will re-apply and stick.

Where a light application is had it should be increased before attempting to release. With trains of over 60 cars it should be increased to at least 15 lbs. below the standard carried, and to 10 lbs. with shorter trains. Of course, it may be necessary at times to release after a slow-down without the reductions stated, but such conditions should be avoided as far as practicable and no release attempted with a very long train after a very light reduction from full pressure.

The proper way to release the brakes on a long freight train after an ordinary application is to use release position for about 15 seconds, return to running position, and, after the brake pipe pressure has equalized but before fully recharged (about 7 to 10 seconds), made a "kick-off" movement, to release for a second or two, then back to running position. If "ET" equipment is had make the first return from release to holding position, make the "kick-off" movement and then graduate off the locomotive brakes by movements from holding to running position and back.

To release when brake pipe pressure is very low, as after being cut off for some time, following a burst hose, etc., the brake valve should have been on lap long enough before attempting to release to obtain maximum main reservoir pressure. Then release position must be used longer than 15 seconds; in fact, until on use of running position the brake pipe pressure is within 10 lbs. of the standard carried. If the rise to this pressure is quick it is then sufficient to make the "kick-off," but which may have to be repeated, as head brakes may have been overcharged more than usual. If the final rise to the pressure stated is slow—a mere "pump-up"—when it is obtained lap the brake valve until full main reservoir pressure is again had and then make the regular release.

Making the "kick-off" movement with the brake valve when the brakes are fully charged is undesirable as it is liable to overcharge the head brakes and cause them to apply and stick. With proper releasing it is rare that any brake fails to release or finally reapplies.

When running, and particularly at low speeds, do not release the train brakes just before or about the time a service reduction is ending, as the reduction will have bunched the slack. This does not apply when standing.

A train should not be held with the train brakes for over ten minutes on a grade where brakes are required to prevent movement. The engine brakes alone will hold a very heavy train on a steep grade if the position of the slack is such as to prevent cars from starting when the train brakes are released; for example, all slack in at the stop on a descending grade.

The value of the engine brake is so great in preventing slack action as to warrant no unnecessary reducing of its holding power. However, drivers must not be slid. While it is known that slippery rails induce sliding, but which condition can be improved by use of sand, it is not so generally known that an equal reason for sliding is slack action that causes a push or pull on the engine, and not necessarily any severe jolt or jerk, an additional reason for avoiding harsh slack action. But at any time that sliding is at all liable the engine man should, with the "ET" equipment, have a hand on the independent brake valve, prepared to partially or wholly release the driver brakes promptly if the circumstances demand.

If with the "ET" equipment the driver brake re-applies ("creeps-on") after releasing the train brakes it generally indicates that the train brake release was not made properly; but the driver brakes should not then be released with the independent brake valve as this will render them liable to "creep-on" again. Instead they should be released by a quick "kick-off" movement of the automatic brake valve.

Uniform and correct regulation of the brake pipe and main reservoir pressures have an important bearing on good braking. Hence, enginemen are directed to see that the air gages indicate correctly and that the feed valves and the governor regulate the pressures at the required amounts and without material variations, reporting them for needed cleaning or repairs in season to insure this. The uniform regulation of brake pipe pressure is particularly important. If the feed valve allows it to vary three pounds or more brakes will be much more liable to "stick" and to "dynamite." The amount of the main reservoir pressure has an important bearing on the promptness of releasing and of recharging the brakes. Too low pressure delays these, and too high pressure causes unnecessary wear and heating of the air compressor. The duplex governor, properly regulated, permits of high pressure when needed, yet reduces compressor labor at other times.

Except where differently authorized the standard freight train pressures are: brake pipe 70 lbs. and main reservoir 90 lbs. low

pressure and 130 lbs. high pressure. If the air gages are correct the hands indicating brake pipe and main reservoir pressure will register alike if, on a light engine, the automatic brake valve (Westinghouse) is in release position. Enginemen should make this simple test each trip and report gages for testing and adjusting whenever the variation exceeds three pounds.

Instructions for Freight Conductors.

Freight conductors should inspect for stuck brakes and damaged draft rigging as trains are pulling out of terminals and, whenever practicable, on starting from points en route. Cars with draft rigging obviously liable to fail soon if nothing is done to prevent must not be taken out of terminals, and where noted at other points should be placed toward the rear if this will answer. Otherwise chain up also or set out if this will not make the car safe, as a break-in-two occasionally causes damage elsewhere in the train.

RAILROAD

Conductor's Break-in-Two Report

Train Direction Date

Eng. No. Engineer

Car or Cars Damaged			Total Cars Coupled		[illegible]		Was Train					Kind of Coupler	Part Failed						Defect		[illegible]	Time of Accident	Delay	
Initials	Number	[illegible]	Loads	Emp.	[illegible]	[illegible]	Starting	Stopping	Running	Backing	Switching		[illegible]	Body	Knuckle	Pin	Coup. [illegible]	D. Timbers	Old	New			Hours	Min.

Indicate following causes by X, but also give full explanation in every case. In (1), (6) and (7) state how many cars from engine.

Break-in-Two Cause	1st	2nd	3rd
(1) Burst Hose			
(2) Brakes Applied from Rear			
(3) Intentional Emergency			
(4) Releasing at Slow Speed			
(5) Start Before Brakes Released			
(6) Knuckle Slipped By			
(7) Coupler Unlocked			
Speed of Train?			
Was Air Cut in to Rear End?			
Were Eng. or Train Brakes Used?			

CONDUCTOR

Make report in duplicate. Mail original to Train Master and copy to Travel Engr.

Form for Conductor's Report.

They should report fully every break-in-two, including "clip-bys," whether or not damage is done, giving reason for failure.

Brake pipe leakage should be stopped promptly. This includes even small ones and particularly so where the total amount is excessive, either as learned from the engineman or observed by the caboose gage. The latter shows it after an application is begun and also when the locomotive is cut off. It is excessive where, with the brakes applied, the leakage alone will reduce the pressure from about 60 lbs. faster than 7 lbs. in a minute. The longer the train the more air is lost with the same rate of leakage.

The caboose air gage is to insure greater safety and better air operation. These ends can be attained where those whose duty it is to observe the gage do so with sufficient frequency and with an understanding of what it can indicate. From the speed, the pressure shown by the gage and the knowledge that should be had as to what the brakes could be expected to do it should be known whether the train can be or is being safely controlled by the engineman. Also, when air brakes are being released and recharged this gage and knowledge of the brake pipe pressure required to insure release (at least 55 lbs. where a service application had been made from 70 lbs. and more if made from higher pressure or by an emergency application) will indicate whether signal to start should be delayed until more pressure is obtained. On a steep, descending grade full pressure should be had before this signal is given.

The conductor should be held strictly responsible for such observance of the caboose gage, either by him or the rear brakeman, as will insure against danger from a closed angle cock or low pressure from any cause. The gage must be observed continuously descending a steep grade. It must also be noted when approaching a meeting point or other place where extra hazard would result from a closed angle cock or low pressure. Where such observations indicate danger take any needed precaution, in the way of signals or application of hand or air brakes, as the circumstances warrant.

Conductors and Enginemen.

Where undesired quick action occurs with proper braking proceed to locate, cut out and card the brake with the faulty triple valve. The difficult one to locate is where it does not "dynamite" at standing applications, appearing to only when making a stop. It will do so just as regularly when standing if the test application is deferred for some time after brakes have been fully

RAILROAD

Engineer's Break-in-Two Report

Train Direction Date Eng. No. Condr.

Total Cars Coupled Loads Empties Number Empties behind Loads

Time Delay Hrs. Min. Nearest mile post or station (Give branch letter)

Was train Starting Stopping Running Backing Switching

If Starting was slack taken? How?

Was steam being used? Light Heavy Speed at break-in-two

Were brakes being released? If so, at what speed?

Were engine or train brakes being used? Speed when shutting off?

How long before brakes applied Am't. first red'n Speed then

Am't. final reduction How far from stop Total reduced just before final reduction (Note: Where engine brakes independent or straight-air used, give brake cylinder pressure where reduction asked for.)

Any previous severe shocks? Where? Cause?

No. of cars from engine where break occurred?

State fully your reason for break-in-two:

Engineer

Make reports in duplicate and mail original to Traveling Engineer and duplicate to Train Master

Form for Engineer's Report.

charged, at least ten minutes. Also when wanted, as when testing for it standing, make a very slow reduction of 3 or 4 lbs., wait on lap until brake pipe leakage has increased this to 7 or 8 lbs. and then, if it has not occurred, add 6 or 7 lbs. in the ordinary manner.

But before starting to test for it, the observers should distribute along the train, standing back about two car-lengths from it so that by hearing, and by seeing in day light, they may note the direction from which the quick action comes and be able thereby to concentrate attention on the part of the train where it starts. After it occurs, and before signal to release is passed to the engine, each observer who thinks he has located the faulty brake should cut out it and two on each side of it. Then, when the other brakes are released he should slowly open each of the cut-out cocks he has closed until the brake starts to release, then move the end of the handle about one-fourth inch farther toward

open position. The object is to make a large enough opening through the cock for the brake to charge and to respond to a service reduction, yet so small that if it applies quick action it cannot reduce the brake pipe pressure fast enough beyond the cock to throw other brakes into quick action. A further advantage of the five brakes almost cut out is that, even if the faulty valve is not among them, they will usually stop quick action and thereby show in which direction further attention should be concentrated.

After the brakes are again recharged and a sufficient time has elapsed (such haste in re-applying as previous undesired quick-action is then a waste of time) the test application should be repeated. If the faulty valve is among these almost cut out it alone will apply quick action and will usually release immediately. If not among these the observers should change to a portion of the train where the quick action came from and then repeat the tests.

When the faulty valve is located it should be cut out and carded. Then, before starting, all other brakes that were almost cut out must be fully cut in. No excuse will be taken for failure in this as any so left might stop desired quick action and, by the slower brake application, endanger the safety of the train. A lesser evil would be that with either desired or undesired quick action the shock from slack action would be greatly increased if quick action could not act throughout the train.

REPLACING THE VACUUM.

A plug railroad in Indiana had one locomotive equipped with two injectors, one of which had never worked. One day the second injector failed to operate and help had to be sent for from a distant machine shop. When the physician machinist arrived and tried to work the injector, he told the man in charge that the throttle of the injector leaked and broke the vacuum which prevented the instrument from raising the feed water.

"That's all right," commented the man in charge, "take out the vacuum and I'll send to William Sellers & Co. for a new one."—*The Scenic Lines Employes' Magazine.*

The Atchison, Topeka & Santa Fe is building a roundhouse, shop, office, sand house, water tank and car repair shed at Brownwood, Tex. The foundations are all in.

LEVERAGE APPLIED TO A FIRE DOOR.*

The accompanying illustrations are of a foot-operated locomotive fire door, which affords a very interesting study in practically applied levers.

The door consists of two similar parts of suitable size to cover the door opening, these being mounted on another casting, which is bolted to the boiler-head in the same manner as the ordinary hand-operated door frame. The two half-doors pivot on two studs, which plainly show, and are so connected by levers that one balances the other, the only force necessary to open them being that necessary to overcome their inertia and the slight friction of the pins, on which the doors and levers turn.

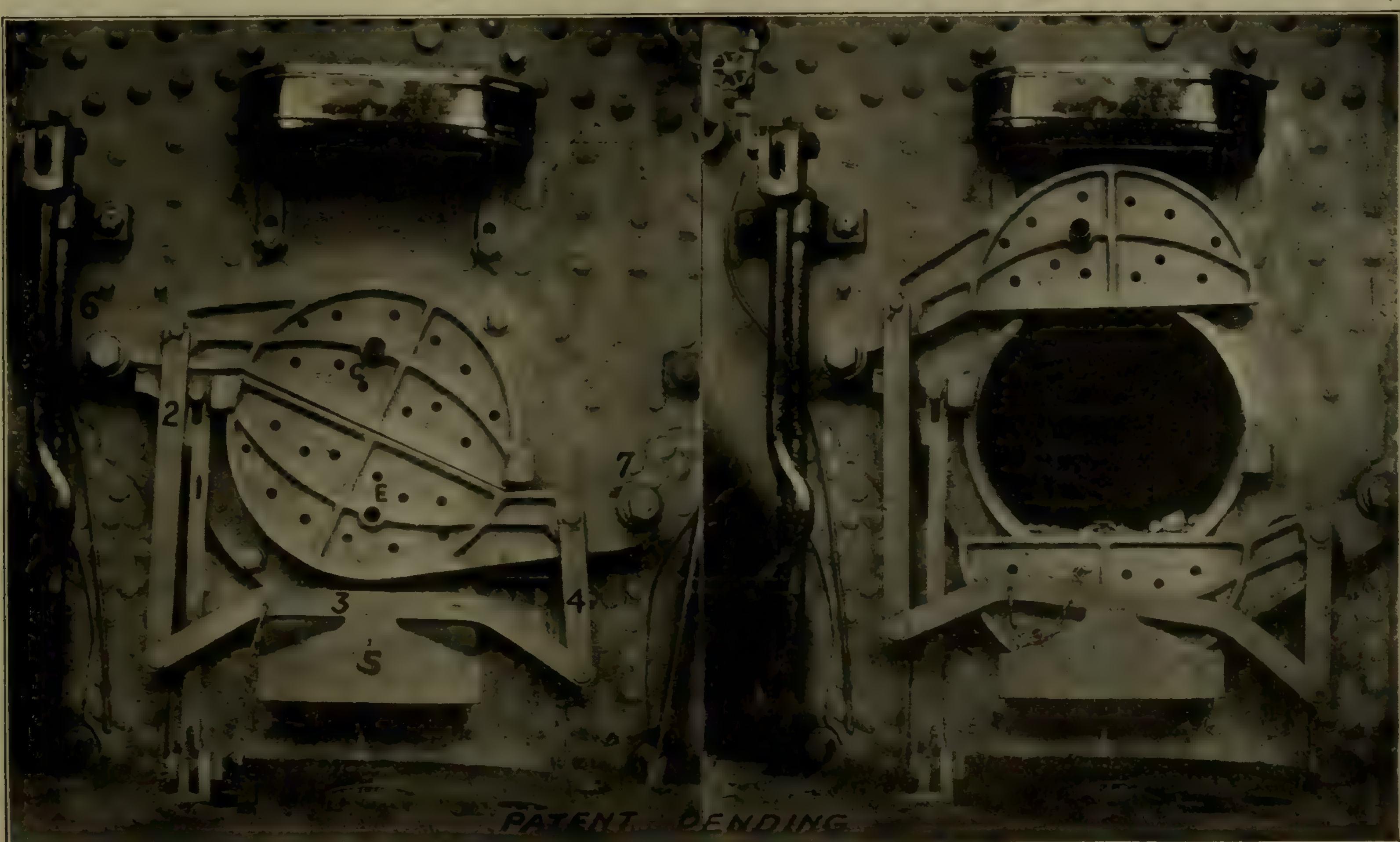
There are two points that are the cause of the door's perfect operation, and it is of these that we wish to write more particularly, as they afford a nice study in leverage.

Upon applying the foot to the foot lever, which has a ratio of about 2 to 1, this pressure is transmited by means of rod 1 to the under side of the upper half-door casting, which is balanced by the lower half, as the distances from fulcrums 6 and 7 to the pins connecting rods 2 and 4, respectively, are the same, and the fulcrum pin 5 being in the center of lever 3. You will now notice that the top of rod 1 is L-shaped (inverted) and somewhat sloping at the left, causing the point of contact to be at the right or nearer the center of the door, giving a comparatively long distance from the pin 6 and permitting a slight force to start the doors open. As the doors open, however, the point of contact moves outward, thus decreasing the leverage, which is not needed now as inertia being overcome the doors are easily kept in motion, but rapidly accelerating the motion of the door with the same rate of movement of the foot lever. This provides an easy starting and rapid opening door.

We stated previously that the door castings are similar, and, in fact, they are cast from the same pattern, but you will notice that the pin for the connecting rod 4 of the lower half-door is almost on a straight line from the main fulcrum pin 7 and the center of gravity of the door (e), while the corresponding pin in the upper door is placed considerably above this line.

In opening, the upper door is a lever of the third class, the

* By W. J. Jarrett, in The Scenic Lines Employes' Magazine.



Denver & Rio Grande Balanced Fire Door.

power from the foot lever, by means of rod 1, and that from rod 2 being applied between the fulcrum and the weight, of course, is the door itself; while the lower door is a lever of the second class, the door being the power applied, and the point of application the pin in rod 4, which is between the power applied and the fulcrum, this power being transmitted by means of rod 4, lever 3 and rod 2 to the upper door.

In closing, the class of the levers is reversed, the upper becoming of the second class and the lower of the third class, the foot lever having no effect now, and you will notice that, in opening, the line of rod 2 is brought much nearer the fulcrum, thus changing the ratio of this lever, giving it a greater leverage, causing it to overcome the weight of the lower door, which remains at practically the same ratio in both positions, and closing the door promptly, this being the effect desired and obtained by making practically a bent lever of the upper door.

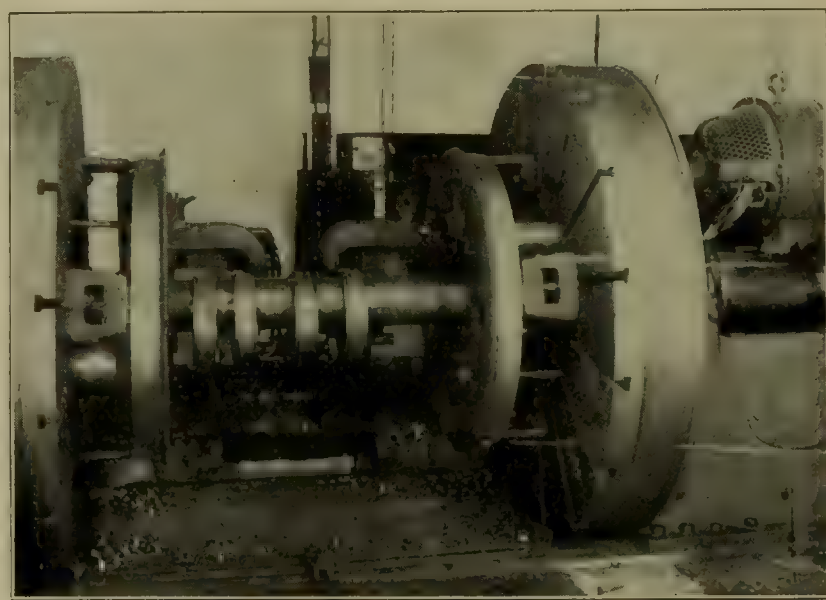
The advantages of this door over those operated by air are many, among which may be mentioned lower first cost, due to its few parts; simplicity of construction and small amount of machine work necessary; practically no cost for maintenance, as there is nothing to get out of order, and its not being dependent on the air supply for its operation.

No additional work is required on the part of the fireman as the act of shifting his weight from one foot to the other in firing gives sufficient pressure to open the doors. Due to the shifting leverage, as above described, the travel of the foot pedal is only about 1¼", this depending upon the amount of opening desired. The doors in service on the Denver & Rio Grande are set to give from 12" to 13" opening. On roads which use an 8" or 9" opening the foot travel could, of course, be decreased.

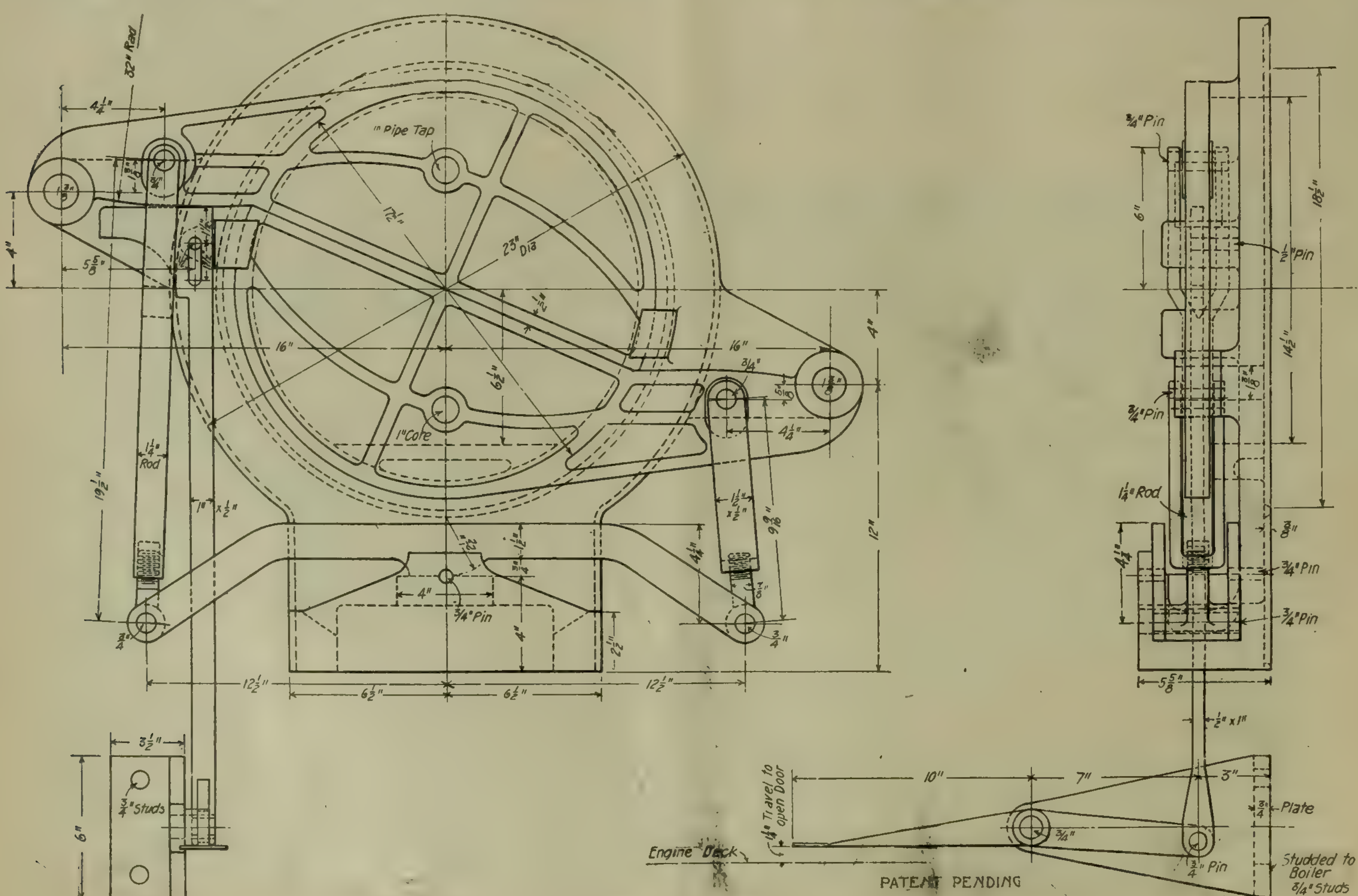
This door affords one of the best examples of the practical application of the principles of leverage that have come under our observation, and is the result of a suggestion of W. O. Cook, general road foreman of engines, developed by G. W. Bashaw, chief draftsman, assisted by P. C. Withrow, mechanical engineer, of the Denver & Rio Grande.

TIRE TURNING TEST.

A driving wheel tire turning test was recently conducted at the Clifton Forge, Va., shops of the Chesapeake & Ohio which is of interest to those who want to get a line on the speed of such operations in shops other than their own. A set of four pair of 56-inch tires were turned out in one hour and fifty-two minutes, the best time made on finishing one pair being 24 minutes. The average time from floor to floor was 28 minutes. A set of six pair of drivers were turned out in two hours, fifty-two and a half minutes. The best time made in finishing one pair of this last set was 28 minutes from floor to floor and the average time was 28½ minutes. The figures and illustration were furnished by E. A. Murray, master mechanic. This is a good record and we would be glad to hear from our readers with regard to similar tests.



Tire Turning on the C. & O. Ry.



Balanced Fire Door Used on the Denver & Rio Grande R. R.

TENDER DERAILMENTS.

By. F. W. Green, M. Am. Soc. M. E.

The elimination of railway accidents is the obvious purpose of the "Safety First" movement, which occupies a prominent place in railway thought at the present time. Of the various kinds of train accidents, tender derailments are perhaps of most frequent occurrence. This discussion will endeavor to ascertain their cause, and to suggest remedies for their prevention.

Assume a tender of the usual type, weighing 140,000 lbs. when loaded with coal and water. It is a common practice to design tenders of rather short length, in order to avoid inconvenience to the fireman in reaching for coal. The capacity necessary to properly serve the large locomotives now in use, must therefore, be obtained by increasing the height. This produces a tender with a low ratio of length to height, and a relatively high center of gravity. The short length requires a rather close spacing of the tender trucks; and this in turn, a rather close spacing between the rear wheels of the locomotive—whether driving or trailing—and the front tender truck. Railway track is not rigid and unyielding, but is subject to depression proportional to the weight of each passing wheel load. Its co-efficient of rigidity, if such a term may properly be used, is dependent upon the character of the roadbed, drainage, ballast, ties and rail. Since this is an extremely variable quantity, inequalities in track level, surface and lines, are the inevitable consequences.

The weight of the tender body and contents is transmitted through center plates to the bolster of each of the two tender trucks, when the track is level and in perfect line and surface. In the case assumed, there would be seventy thousand pounds carried upon each truck; and one half this amount, or 35,000 lbs. on the two wheels on each side of each truck. As long as perfect track continues the wheel reactions will remain equal, but as soon as uneven track is traversed, the wheels will naturally follow the depressions and irregularities in the track. Suppose the front track falls into a depression. Both truck wheels go down on the right side, relaxing the right front truck springs correspondingly, which in turn produces a compression of the track springs on the left side of the front truck, causing an upward thrust upon the left front side bearing. This upward thrust is then transmitted to the tank body causing it to rock to the right. The right back side bearing then comes into play, receiving the downward thrust due to the rocking of the body, and transmitting it to the right back truck springs. On the rebound the left front side bearing again comes into play but with a reversal of function—receiving a downward thrust this time, instead of imparting an upward thrust as before. Briefly then, the rocking of the tank body, which is caused by inequalities in the track, ordinarily is eventually dampened or dissipated by the truck springs absorbing shocks imparted to them through the side bearings.

We will now assume further that track irregularities, low joints for example, occur at regular intervals. When such places are encountered in the passage of the train, if the rocking of the tank body is contrary to the effect produced by the low joints, the condition resulting is illustrated by Fig. 1, in which it will be observed that the motions tend to neutralize each other. But, when the rocking of the tank body is synchronized, as it were, with the low joints, then the resulting condition is shown in Fig. 2. In the latter case violent shocks are produced at a time when the dampening effect of the truck springs is a minimum and they are unable to perform their proper function.

As before stated, when the track is level, the entire weight of the tank body is transmitted through the center plate equally to the wheels on each side of the truck. But when the tank body is rocking, this condition does not exist; a portion of the weight is taken from one side and added to the other, with each swing of the tank body. The numerical value of this weight is of course, proportional to the distance the side bearings are located from the center plate, the strength of the truck springs, the height of the center of gravity of the tank body above the center plate, and the amplitude of the swing. If we call the normal weight N, and the abnormal weight A, then when there is no swing, A equals zero. But when the body is rocking, one side of the truck has a reaction, N plus A, and the other side, at the same instant, a reaction equal to N minus A. Now, N plus A is greater than N minus A. We have therefore a greater weight on one side than on the other with a constant force exerted through the center pin, and equal lever arms from center pin to wheels on either side. When forces are equal, the rates of acceleration are inversely as the weights. In other words, with a given pull through the draw bar, transmitted through the center pin to the truck bolster, the side of the truck having reaction N minus A will move faster than the side having reaction N plus A. If A is large enough, and the force transmitted through the draw bar is great enough, it inevitably follows that the truck must tend to revolve in a horizontal plane with only the wheel flanges to resist this tendency.

We have thus seen how tender derailments are produced. Derailments of any other cars are produced in the same manner, but are of somewhat less frequent occurrence, because of lighter loads, lower centers of gravity, etc. The remedies for their prevention seem to be indicated along the following lines:

1. Track conditions should be made as nearly perfect as the present state of the art will permit.

2. When imperfect track is unavoidable the speed of trains should be reduced to such a point as to avoid excessive rocking of the tender body.

3. Tenders should be constructed with as long a wheel base, and with as low a center of gravity as conditions will permit. Side bearings outside the truck frames should be prohibited, and wide spacing of side bearings avoided, on account of their producing an increase in the value of A. At the same time too close a spacing of the side bearings should be avoided because of the decrease in the dampening effect of the truck springs thereby produced.

4. Truck springs should be of ample capacity to absorb maximum shocks without completely closing, in order to extend the effect of the shock over as long a time as possible. It is usually the instantaneous shock transmitted when the truck springs are fully compressed, which derails the truck.

5. Enginemen should be trained when encountering a dangerous place in the track that the best course, is merely to shut off steam, when there is not time for brakes to take hold. When they "keep the slack stretched" by working steam over such places, they make matters very much worse, because the force acting through the center pin increases the magnitude of unbalanced forces, and therefore increases the tendency of the truck to derail.

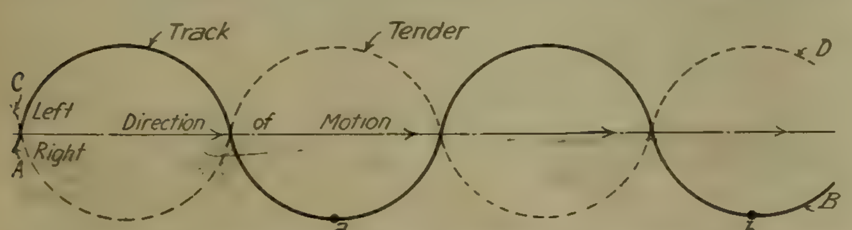


Fig. 1—Curve A-B Represents the Track with Low Joints at *a* and *b*. Curve C-D Represents Swing of Tender Body.

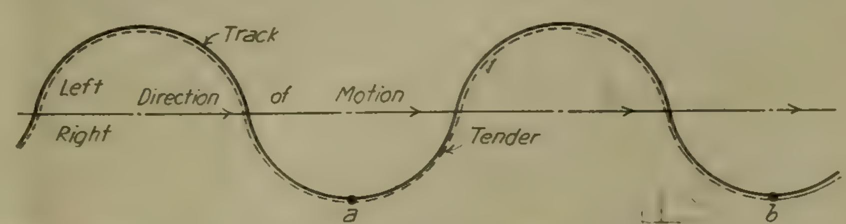


Fig. 2—Solid Line Curve Represents Track with Low Joints at *a* and *b*. Dotted Line Represents Swing of Tender Body. Note That Here Two Curves Are Synchronous.

6. Mechanical foremen and others should be cautioned against experimenting with "three point suspension" and similar theories. They have all been tried out and have been found to introduce more difficulties than they eliminate. For example, when front side bearings are eliminated entirely, the rear side bearings are called upon to dissipate all oscillations produced, and the rocking of the tank body becomes worse than before.

7. Heavy equipment should follow, and not precede, the strengthening of track and roadbed.

INCREASING SHOP OUTPUT.

By William Hall.

An important question of the day is, how can the ordinary mechanic be brought to see that coöperation on his part in increasing the output of the shop will be to his own advantage. If this article brings out suggestions or criticisms that may be helpful, I shall feel amply repaid for my trouble in advancing the following.

It is said that you can't keep a good man down. By that I mean a man who has ambitions and aspires to improve his condition, and rise step by step until he reaches the highest rung of the ladder. While this may be true in some cases, it will be found that those who have attained that for which they aspired, have received more or less encouragement from those higher up, with a prospect of further promotion from time to time, as opportunity would permit.

Of late years, however, the ordinary mechanic has had a very poor show, for it has been the policy of most railroads and manufacturing concerns to give the preference to the technical graduate. He is given a special apprenticeship and is given to understand that as vacancies occur he will have the first chance for promotion. This has had its effect on the ordinary mechanic who has learned his business from actual experience and hard knocks, and in a great many instances this actual experience has been reinforced by many hours of hard study and self-education along technical lines.

The promotion of the technical graduate in preference to the ordinary mechanic has deterred the best of the rank and file from bringing out ideas that if put into practice would materially increase the output of the shop. Placing men who know absolutely nothing whatever of shop work or shop practices in positions over mechanics is pure and simple favoritism, and does not make for efficiency. Another reason that the coöperation of the ordinary mechanic is not obtained is that he can see for himself that the best efforts of a man are not always appreciated. He sees for himself that the superintendent is not kept in touch with the men who are working for the best interest of the company, but depends upon the reports of the man between himself and the mechanic, who is jealous of his knowledge and afraid he knows more than his immediate superior. Many a good man has been downed by his immediate superior because of selfish motives, or a desire to replace him by some favorite. This does not apply to the mechanic alone, but to foremen also and in this statement can be found an answer to the question propounded by the technical press a short time ago, "Why is it that so many foremen are changing or looking for positions?"

Another reason why foremen and the ordinary mechanic are backward in advancing new ideas is that if his ideas are not frowned upon he is robbed of his ideas by his superior. The man higher up is not advised of the proper source of the idea or suggestion, thus destroying all ambition in a man who is striving to the front

Several suggestions have been made to remedy the evil, such as following closely the capabilities of a man, and promoting the man found with the necessary qualifications, encouraging the advancement of ideas and rewarding the right man. But who is to be the watcher of these ambitious kind of men? Not the superintendent, but the man holding an inferior rank. Therefore these suggestions fail of equity and not until men are appointed to fill such positions as general foremen and master mechanics, who are big enough to think, at least, that the man below him is as good a man, or even a little better, than he is himself; who are willing to treat all employees with fairness, truthfulness and courtesy, will he gain the utmost respect of the men, and then, and not until then, will the coöperation of the employees be obtained in an effort to increase the shop output.

Quite a number of the railroads, as well as some of our commercial houses are adopting the plan of remunerating their employees, for ideas that may be advanced by them, regardless of their position. When this requisite (coöperation) is obtained, the men will be encouraged to study technical books, magazines, and mechanical drawing, and men will strive to be leaders instead of followers. Not that all men can be leaders, for there must of necessity be followers, but when a man sees that his efforts are appreciated he will put forth all there is in him.

Another requisite in obtaining the coöperation of the men is cleanliness in his suroundings. It is very essential to the maintenance of efficiency of the men, both in the back shop and the roundhouse, that these places be kept clean and light. A man's efficiency is dependent upon his willingness as well as his ability, and willingness is influenced by his surroundings. A better moral tone should be encouraged in the men, and incidentally should be practiced by some of the superiors.

If the shop output is to be increased, it is of the utmost importance that the individual mechanic be carefully studied so that his conditions may be improved and encouraged to make a greater effort.

The Illinois Central has announced that an order for expense aggregating $1,000,000 has been made for the construction of new freight terminals and freight depots at Evansville, Ind.

The Illinois Central is building a complete engine and car repair terminal at Nonconnah, Tenn., at a cost of $600,000. George B. Swift & Co., of Chicago, has the contract.

RIGHT OF WAY

CLEVELAND PLAIN DEALER

THE FREIGHT CAR QUESTION.*

By D. J. Durrell, M. M. Pennsylvania Lines West.

The subject of freight car standardization is one that will be a very live one before the railroads during the next few years. For a quarter of a century or more, the Master Car Builders' Association, the leading master car builders, superintendents and other railway officials of high order have given the question of car equipment considerable attention and much credit is due the untiring efforts of individual members of the association, whose work has been of untold benefit to the railways of the world and brought the standard of railway rolling stock to a degree of proficiency almost undreamed of within the past thirty odd years. Yet, because of the fact that so many master car builders and others have had personal views regarding car construction, and have been using the same old designs for many years, together with the various car building companies seeking to sell their product regardless of its not having been built according to recommended practice, and a desire to use what should have been considered obsolete patterns, every lot of cars turned out have had details of construction greatly at variance with those previously built, and as a result after all the efforts of the men who have done so much along the lines of car design, there is scarcely a road which has in its equipment that which is in accordance with recommendations of the Master Car Builders' Association, excepting such details as wheels, oil boxes, axles and brasses and a few other such details, and only because of the recognized advantages of the details I have mentioned, have we those few M. C. B. standards in our cars today.

In October, 1901, the American Railway Association adopted the following resolution:

(1) *Resolved,* That the dimensions of the standard box car be 36 feet in length, 8 feet 6 inches in width and 8 feet in height, all inside dimensions. Cross section, 68 square feet; capacity, 2,448 cubic feet. The side door opening to be 6 feet in width.

(2) *Resolved,* That the standard 36-foot car be considered the unit for the establishment of minimum carload weights; and that where necessary in any classification territory to recognize cars under 36 feet in length it shall be by a reduced minimum of 2½ percent for 35-foot cars and 5 percent for cars 34 feet or under, inside dimensions.

(3) *Resolved,* That for cars over 36 feet in length the percentage of increase of the minimum weights shall be as follows:

For cars of 37 feet and 38 feet, 10 per cent over the minimum for the 36-foot car.

For cars of 39 feet and 40 feet, 25 per cent over the minimum for the 36-foot car.

For cars of 41 feet and 42 feet, 40 per cent over the minimum for the 36-foot car.

For cars of 43 feet and 44 feet, 55 per cent over the minimum for the 36-foot car.

For cars of 45 feet and 46 feet, 65 per cent over the minimum for the 36-foot car.

For cars of 47 feet and 48 feet, 70 per cent over the minimum for the 36-foot car.

For cars of 49 feet and 50 feet, 80 per cent over the minimum for the 36-foot car.

For cars over 50 feet, 150 per cent over the minimum for the 36-foot car.

(4) *Resolved,* That any diminution of revenue incident to the minimum proposed in the accompanying schedule shall be adjusted in the rate.

(5) *Resolved,* That the minimum carload weights of heavy articles, such as iron, brick, lumber, minerals, etc., should, as fast as practicable, be advanced to the stencilled capacity of the car.

(6) *Resolved,* That no box cars of larger dimensions than those prescribed for the Standard Car should be hereafter constructed, and that all owners and builders of cars be officially notified of the adoption of this resolution. Adopted October 23, 1901.

* Extracts from a paper read before the Cincinnati Railway Club.

I am advised that in this connection a copy of a circular has been issued by the committee on maintenance, American Railway Association, under date of October 18, 1913, relative to increasing the inside dimensions of a standard car to 40 feet, 6 inches in length; 8 feet, 6 inches in width, and 9 feet in height, with a maximum outside dimension of 9 feet, 2 inches in width at 13 feet above top of the rail.

The point might be raised that if we adopted standard construction we would stop progression, but I feel that the future development of car construction would take care of such new features without causing confusion.

I know personally, a few years ago, of box cars being built by a car company in Ohio and sold for the sum of $427, at the same time the road with which I was connected was building their own cars at a cost of $850, and yet the cars of each road were handled in interchange on roads all over the country, with the result that the cheaper cars were constantly proving defective, and causing the roads handling them much more to repair than their own equipment. Let me cite the question of journal brasses as an illustration; some roads use metal costing nineteen to twenty-one cents per pound, according to the price of copper, others buy brasses which cost them fourteen to sixteen cents per pound, and when a car with the cheaper brass gets on to a road using the better quality of metal in its brass, it frequently happens the cheaper brass breaks, journals are cut and the road handling the cars is obliged to take out the poor brass and substitute the higher price brass, all of which means not only a loss to the road handling the car, but delays to traffic. I made an estimate along this line some few years ago, and found that one of the large systems was losing approximately $750,000 yearly from this source alone.

Before proceeding further let us see what constitutes this revenue freight car equipment. On Classification of Equipment, Form 7 on file in the office of the General Agent of the American Railway Association, at Chicago, for the month of June, 1913, is the following data, taken from replies of 160 roads operating 232,408 miles:

Box	1,095,727
Refrigerator	51,974
Stock	81,809
Tank	12,365
Flat	139,866
Dump	35,126
Steel Hopper	205,661
Wood Hopper	128,270
Coke	38,054
Steel Gondola	155,843
Wood Gondola	292,252
Other Revenue	29,708
Total	2,266,655
Caboose, Work, etc.	129,342
Grand Total	2,395,997

On October 1 of this year the actual number of revenue cars owned by railroads was 2,360,754. You can readily see how the number grew in the several months from June 1 to October 1. The figures which I give are for all railroads in the United States and Canada.

Let us see how these cars are located; how they are running:

Home cars on home roads	1,292,158
Home cars on foreign roads	1,068,596
Foreign cars on home roads	1,137,200
Cars away from home	2,205,796

This is a tremendous number out of the total cars owned.

Home cars in home shops	144,568
Foreign cars in home shops	32,546
Total cars in shop	177,114

For year ending October 1, 1913, there had been, putting it in this way—"One car, so many days out of service on account of bad order,"—53,309,507 car days, or an average number of days, each car was out of service during the year of 22.53. What does this mean, a foreign car or a car away from home, making it a foreign car? It means that the road having that car on their hands must either make wrong repairs, put on defect card and send car home, or they must hold it until they receive material with which to make repairs or they must carry in stock sufficient material to make repairs, in order to get the car off their hands. In the meantime that car is earning nothing and the railroads are consequently losing the revenue which they might derive from same.

Let me give you some more figures. I know these figures are dry, but it is interesting to know them in view of the fact that so many of the cars owned by each road are away from home, making them foreign cars.

Dividing the United States and Canada into eleven districts and taking the number of cars owned by the lines in each district, we find that of all the cars the per cent to total cars owned is:

	Min.	Max.	Avg.
Home cars on home roads	36.37	67.63	54.73
Total cars on lines	89.31	143.35	102.91
Home cars in home shops	2.69	8.01	6.12
Foreign cars in home shops	.33	3.02	1.38
Total in shops	4.87	11.03	7.50

By these figures you will note that the average number of cars owned, that is, home cars at home on their own road was but 54 per cent of the cars owned. Also that the total cars used compared with those owned varied from 89 to 143 per cent, an average of 102 per cent; in other words, some roads used 43 per cent more cars than they owned, or 43 cars in addition to every one hundred which they owned. These figures seem large, but they have been verified by reports from the American Railway Association and I feel they can be depended upon, and it means a great deal to the railroad companies. Taking the figure I gave you a few moments ago of 32,546 foreign cars in home shops, at a per diem charge of 45 cents per day, means $14,645.70 per day for per diem, or for a 365-day year $5,345,680.00 of per diem charges. The question may arise, or some one may say that the five million dollars thus represented does not get out of the coffers of the railroads; that it merely passes from one to another and back again. That is very true, but at the same time the cars have been out of service and considering one day as a basis which we have taken and which everyone understands is way below the actual time that foreign cars are held on their repair tracks, we have run up a total yearly per diem charge of over five million dollars and additional days but adds to this figure.

The question is, are the railroads going to recognize the fact that something will have to be done towards designing and building standard freight equipment? The Interstate Commerce Commission has given us prints and printed instructions for grab-irons and safety appliances for our cars and for steps and safety appliances for locomotives and I feel that it is reasonable to expect that within the next three or five years that they, if not the railroads, will issue to us standard drawings and dimensions for cars, which we will be obliged to follow under direction of the Interstate Commerce Commission. It is incumbent on the railroads to get busy. I predict that the time is not far distant when the Interstate Commerce Commission will take such course, and that a limit will be put on the present equipment as to time in service, according to age and construction and I believe that after a certain period all cars will be built after drawings and specifications furnished by the Interstate Commerce Commission. I feel further that a reasonable time will be set as to the service to be rendered by the cars then in commission or under construction on a mileage basis and they will then have to be withdrawn from service; it may be 15 or 20 years, but I feel that the question will arise.

We all recognize the fact that government control of railways will force us to standard equipment and while many are indeed skeptical regarding the ultimate outcome, let me call attention to the fact that a number of the states have already passed bills governing car construction and as a case in point I cite senate bill No. 298 passed by the state senate of Ohio, April 28, 1913, and approved by the Governor on May 5, 1913, which is an act to regulate the size and construction of all caboose cars used by any common carrier in this state.

There are many of our leading railway men today who feel that affairs along this line are swiftly treading towards government control. Let me read what some of the leading railway men have to say on the subject:

Mr. Mellen, ex-president of the New York, New Haven & Hartford Railroad is quoted by the Boston Post of November 9th in part as saying:

"The railroads will all go under government ownership. It is coming quickly. Five years ago I felt that I should not live to see it. But now I think that I shall. Regulation by the government during the last ten years has tended to lower the value of railroad stocks as investments. There is not the big money in railroads that there used to be. There will not be any opposition to government ownership when the time arrives, because private capital will find the field unprofitable as a result of the too strict regulation."

Ralph Peters, president of the Long Island, who is known and dearly beloved to many present, is quoted as saying in a letter discussing federal ownership of railroads: "I have no doubt that the owners of the roads will gladly welcome government ownership, since it will relieve them of the financial responsibility for their properties, the operation of which they practically no longer control. However, I do not believe that the people of this country are yet ready to change the form of our government, which certainly will be the result if we undertake government ownership and operation of railroads, telegraphs and telephones and similar business utilities."

In relation to standardization of freight car equipment, E. P. Ripley, president of the Santa Fe, in The Monthly Railway Official List for September, 1913, says in part:

"I suggest a standard car uniform in all essential details to be arrived at by agreement, if possible—arbitration if necessary. If in addition we could establish a freight car pool, or an equipment company, the stock of which should all be owned by the railroads, so much the better. There is no sort of doubt that we shall be forced to something of this kind eventually. Why not make the attempt to do it voluntarily and properly instead of being obliged to do it by law with the necessary accompaniment of federal inspectors and the cumbersome and other impractcable notions of the particular politicians who happen to be making laws for us at the time?"

For the purpose of training young men who contemplate entering railroad service the University of Pittsburgh with the coming fall term will inaugurate a comprehensive course in railway mechanical engineering and administration. In this course such subjects will be given as materials of railway construction, operating units, railway design, utilization of locomotives and cars, maintenance of locomotives and cars, railway shop methods, fundamentals of railway practice and thesis; the two latter features under the direction of D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West. It is intended that the course will be closely affiliated with the railroads and that the students shall be given an opportunity to study modern methods of railway operation through the courtesy of the managements of the railroads in the district. Students shall be taken on inspection trips, assist in tests and become acquainted with the various phases of operation.

The Air Brake Association will hold its twenty-first annual convention at the Hotel Pontchartrain, Detroit, Mich., on May 5, 6, 7 and 8, 1914.

Shop Kinks, Canadian Northern Ry.

The accompanying sketches show a number of shop kinks in use on the Canadian Northern Ry., which have been installed under the supervision of H. Ashton, chief mechanical inspector.

Figure 1 shows a machine shop crane to serve 90" driving wheel lathes in roundhouse machine shops. The span is sufficient to include the narrow gauge track from the engine house proper and to handle running gear, engine trucks and tender trucks. Six ton hoists with a five foot stroke are being used for this work.

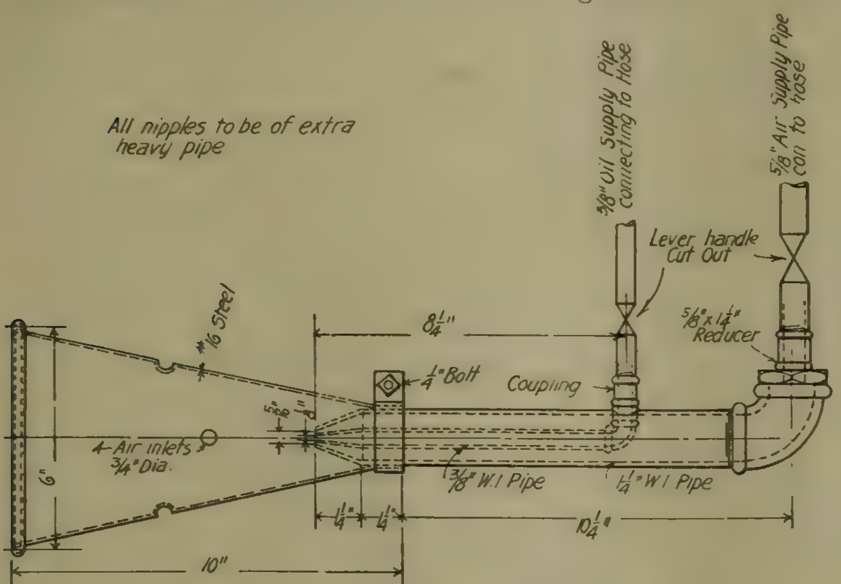


Fig. 2—General Arrangement of Oil Heater.

Figure 2 is an oil heater designed for small work such as filling mud ring corners and heating firebox patches. It is extremely simple and safe, in that all parts are integral in one piece up to within 8" of the nozzle tip. This precludes the danger of trouble on account of parts becoming accidentally disconnected. The joint between the pipe and casing of boiler is tightly packed with asbestos.

The wheel tongs, illustrated in figure 3 are in use by a number of wheel and foundry companies as well as by the Canadian Northern.

Figure 4 shows all the information with regard to a paint sprayer, which has been found to be very efficient. It connects to the regular shop air line.

A novel design of a combination gauge for checking the contour of bearing wedges and brasses is shown in figure 5. All inspectors are furnished with these and they are found to be very serviceable.

There are a great many different kinds of machines for repairing and renewing air and steam hose, but after going over the whole matter carefully and cautiously, the Canadian Northern decided that the arrangement shown in figure 6 is as good a device as could be set up within the space allotted, and furthermore, requires very little material which could not be supplied by the railway company. First of all, the rubber hose is held stationary by the force exerted from the top 3½" x 4"

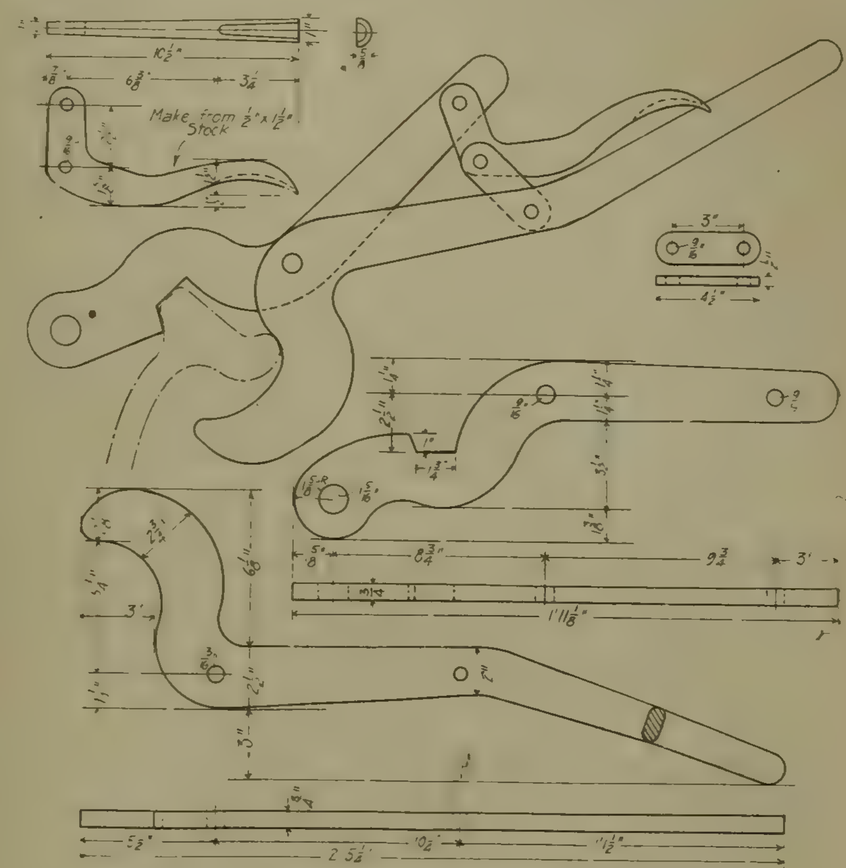


Fig. 3—Wheel Tongs.

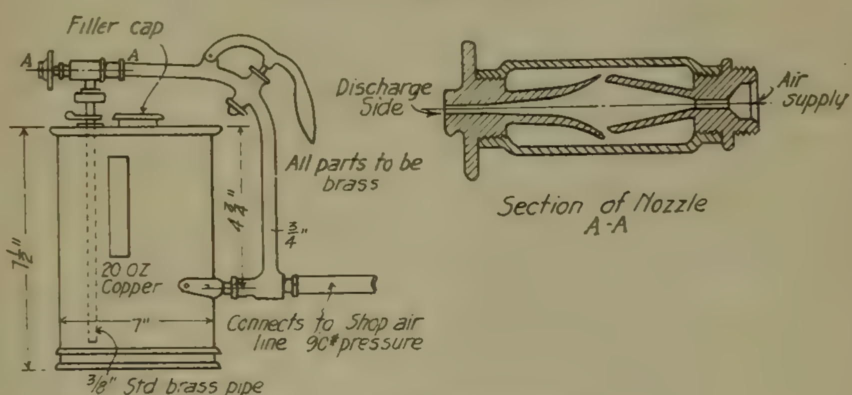


Fig. 4—Car Paint Sprayer.

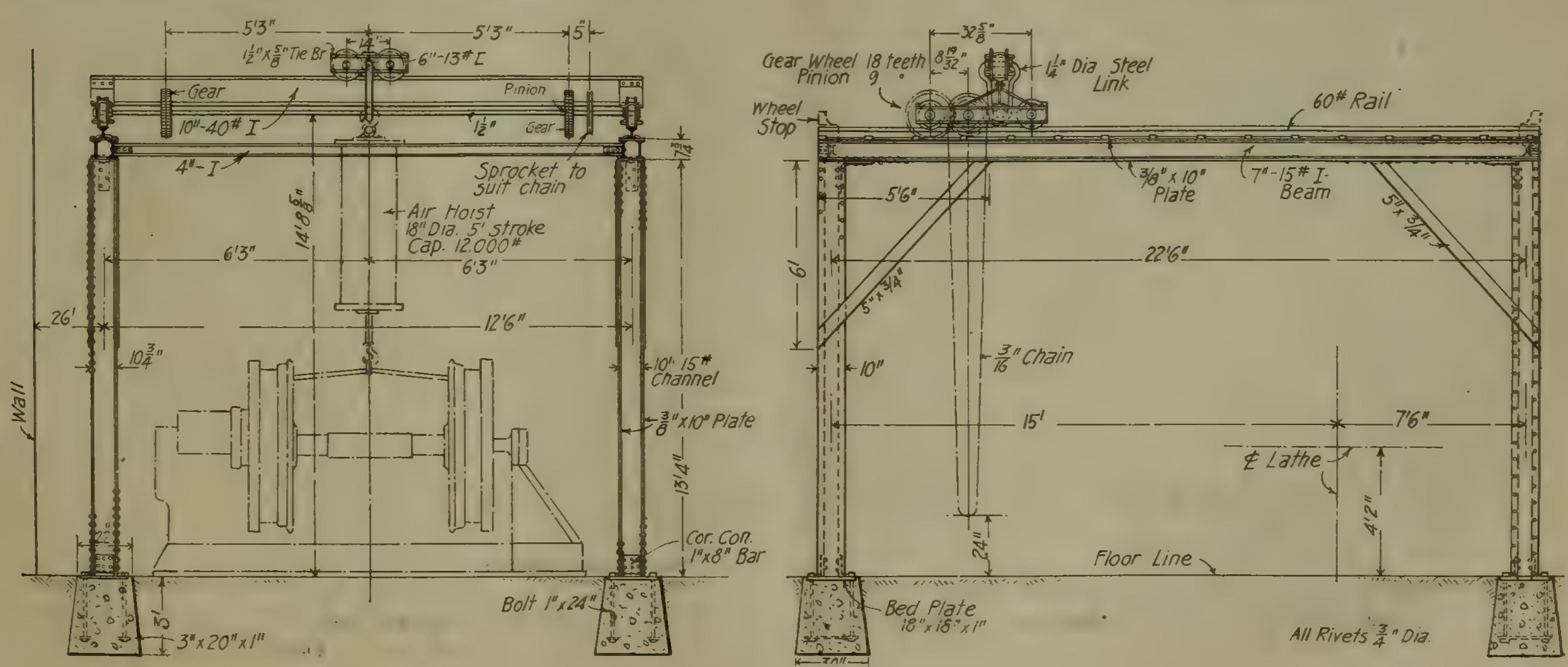


Fig. 1—Machine Shop Crane, Canadian Northern Ry.

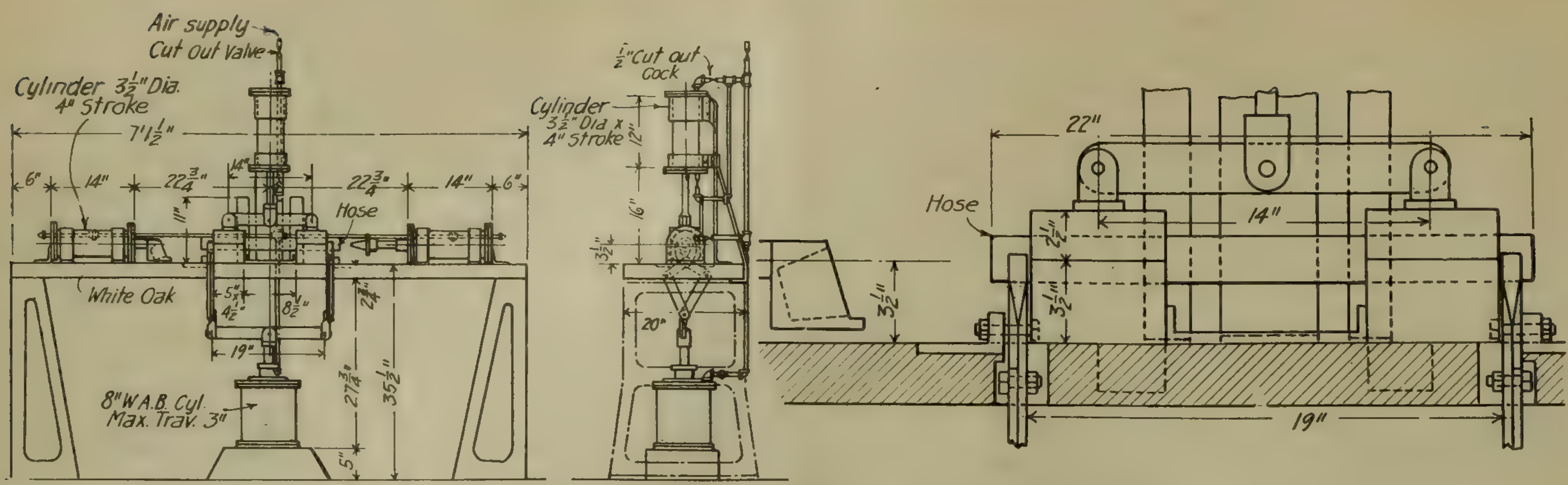


Fig. 6—General Arrangement and Detail of Hose Mounting Machine.

cylinder, through two wooden clamp blocks connected up to piston rod through a 14" symmetrical lever. The nipples and couplings are forced on by the same size of cylinders placed horizontally on top of bench. This gives a very flexible arrangement, for where different lengths of hose are used the necessary variation may be taken up in the piston rod connections or the cylinders moved. This is not necessary at the present time on

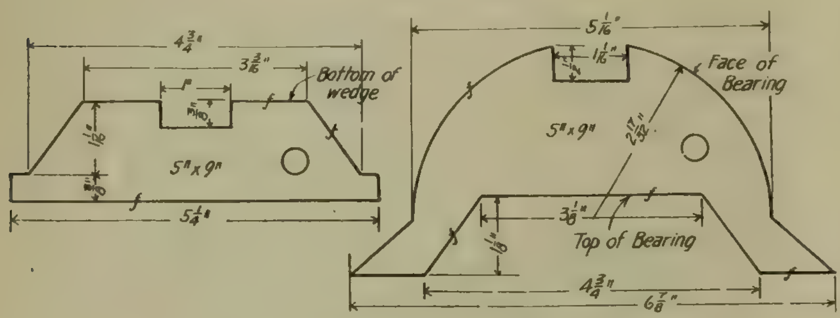
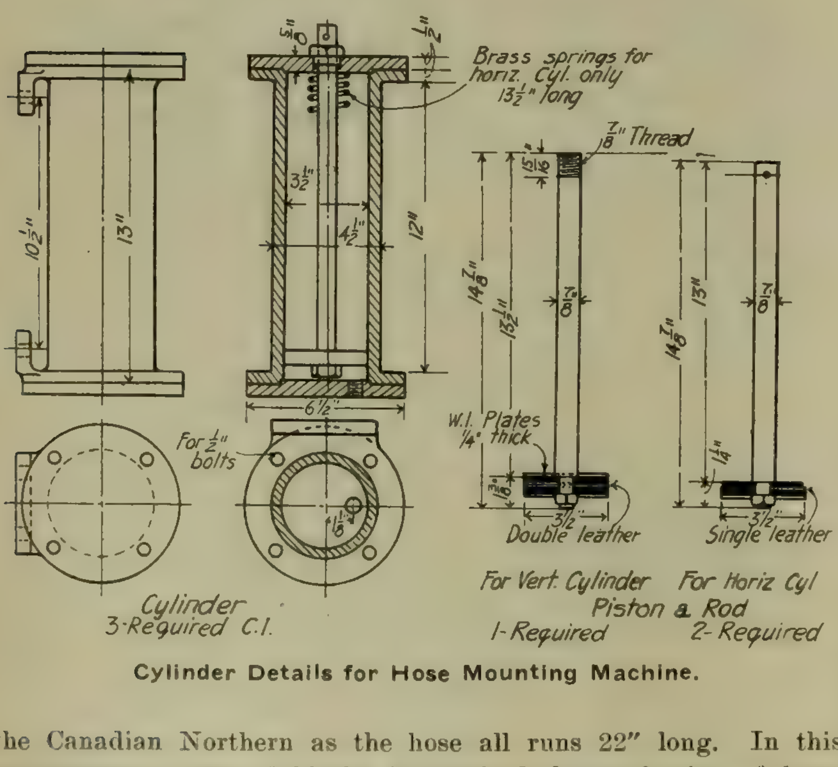


Fig. 5—Journal Bearing and Wedge Gauges.



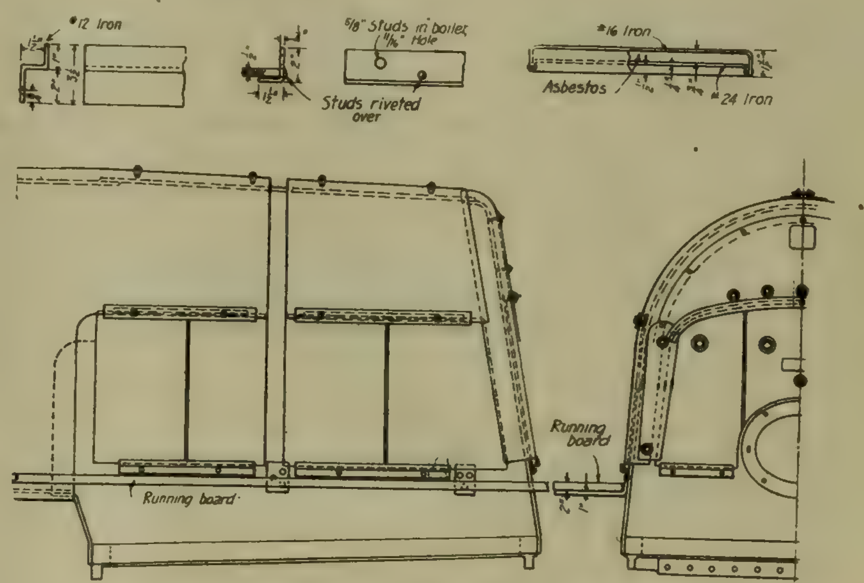
Cylinder Details for Hose Mounting Machine.

the Canadian Northern as the hose all runs 22" long. In this arrangement a set of blocks is required for each size of hose, 1", 1⅜" and 1½", to suit the style being run. The principal feature of merit in this device lies in the operation developed by the 8" brake cylinder, which has a travel of 3" maximum, brought about by reducing the regular spring by 8". In placing the hose clamps, the first step is to slip them on loosely by hand and by operating the last mentioned cylinder, which has connected to its piston a 19" symmetrical employing a pincer arrangement at each end, on the clasp brake principle, so arranged that as the full travel is approached these grip around the hose clamp, forcing it tightly in position. The bolt is then inserted and secured in the usual manner. All is brought about on one machine, through a single mounting and the hose is not released or removed until absolutely completed.

METHOD OF LAGGING BOILERS.

By P. E. Cosgrove, Fmn. Boilermaker, E. J. & E. Ry.

The sketch shows an improved way of lagging a boiler on or around the back end, to enable workmen to renew broken staybolts with the least possible trouble and at a low cost. We are using what I call a panel jacket made in sections and filled with asbestos. These panels can be removed very easily and it saves making a nasty mess all around the engine. They are made to suit the space and can be taken off and put back in a short time, as there is no stripping to be done.



Removable Jacket Panels for Lagging.

We instruct our pipemen, in placing all outside piping around the boilerhead, to place it at least an inch and a half away from the jacket. This allows the panels to be slipped out very easily. We also cover all our flexible staybolts with it. We have been applying this for over a year and find it a very profitable proposition, for where we have only two or three bolts to remove we don't have to strip a whole side. Also, we have done away with all steps near the cab and have substituted a small ladder from running board to hand rail, thus eliminating all leaky studs.

Railroad ditching was illustrated with lantern slides and motion pictures at the annual banquet of the Minnesota branch of the American Society of Mechanical Engineers at the Saint Paul on January 7. Oliver Crosby, president of the American Hoist & Derrick Co., was the lecturer.

The new station of the New York Central lines at Rochester, N. Y., has been opened to the public. The building was more than three years in construction. The new station yards have 8.2 miles of track and capacity for 225 cars.

A MODERN CAR REPAIR SHOP.

By C. L. Bundy, General Foreman, D. L. & W. R. R., Kingsland, N. J.

Layout by R. C. Bundy.

I think I may safely say that the art of designing, equipping, and operating a railroad repair shop has not up to the present time been reduced to the science of a perfect plant from the standpoint of economical operation. It would be hard to build a plant that would be considered by all car men a perfect plant and, no doubt, such a plant will never be built. However, we should profit in a measure by plants built in the past and get as near a modern up-to-date plant as it is possible to do.

Such a plant should be designed keeping in mind that the different departments should be as convenient to each other as possible, in order to reduce the cost of handling material to its minimum.

Wooden cars are fast giving way to steel cars and shops built in the future should be built for the handling of heavy steel car work. The centralization of repairs in one shop can not consistently be done to advantage with a possible exception of passenger cars. Therefore, it seems the best policy to have division shops able to take care of bad order cars over that division.

Shops should be located at a point where cars are made empty, if possible, to save switching. Bad order storage tracks should be provided for each shop and to equal the shop in capacity.

The lay-out of a passenger and freight shop shown on blue print attached is the work of R. C. Bundy, of East Orange, N. J., now in his third year of high school and who is seventeen years of age. The lay-out of this plan is of his own design, having received no assistance from any one.

A shop built after this plan would be able to take care of 1,000 passenger cars shopping them every fifteen months and approximately 25,000 freight cars. The ideal construction for the buildings would be concrete foundations and floor, brick walls with a concrete roof supported with trusses of structural steel. The grounds around the shop should be graded to a level of the shop floor and covered with about two inches of crushed stone.

The shops and yards should be provided with a system of industrial tracks and turn tables, about 2′ 6″ gauge, for the convenience of handling materials.

The tracks should be located at twenty-five feet centers with the exception of the coach paint shop, where they may be located at eighteen feet centers.

The passenger and freight shop should be equipped with a fifteen-ton crane covering four tracks in each shop for the convenience of unloading, and handling of heavy materials, and wreckage. The entire passenger and freight shop should be equipped with stationary scaffolds for the convenience of the workmen, same to be ones that are easily adjusted.

A tool room should be installed in the passenger and freight shop for the care of all air and hand tools. These tool rooms should be in charge of a competent man who will keep a record of the tools and see that they are returned by the workmen when they are through with them.

The floor between the tracks in the paint shop should pitch to an open concrete sewer in the center of the track. These sewers to have an outlet to the main sewer at intervals of about every 50 feet and to be covered over with perforated iron plates so that they may be removed and sewer flushed out when necessary.

In the dry lumber shed, a moulding rack with sufficient compartments should be provided for all standard moulding, which should be carried in stock for use at all times.

A water tank to be used in emergency in case the fire pump should fail, elevated to a height to give sixty pounds' pressure, should also be provided for.

Sufficient metal lockers should be provided so that the workman may have a place for his clothes and lunch pail.

The varnish room should be provided with adjustable sash racks so that they may be regulated for any width sash that they should be wanted for. In addition to this the varnish room should be provided with door racks so arranged that the doors can be stood on their end. The varnish room should be supplied with sufficient tables covered over with zinc.

In the scrub room, two tanks should be provided for with hot and cold water and steam. These tanks should be 18 inches deep, six feet wide, and eight feet long, set about twelve inches from the floor.

The passenger repair shop should be equipped with the following tools: One tire lathe, one axle lathe, one wheel press, one wheel bore, one drill press, one nut tapper, one bolt threading machine, one pipe threading machine, one small speed lathe in tool room. These tools, installed in the coach shop, would save the handling of wheels and other repair parts over the transfer table and thereby considerable money.

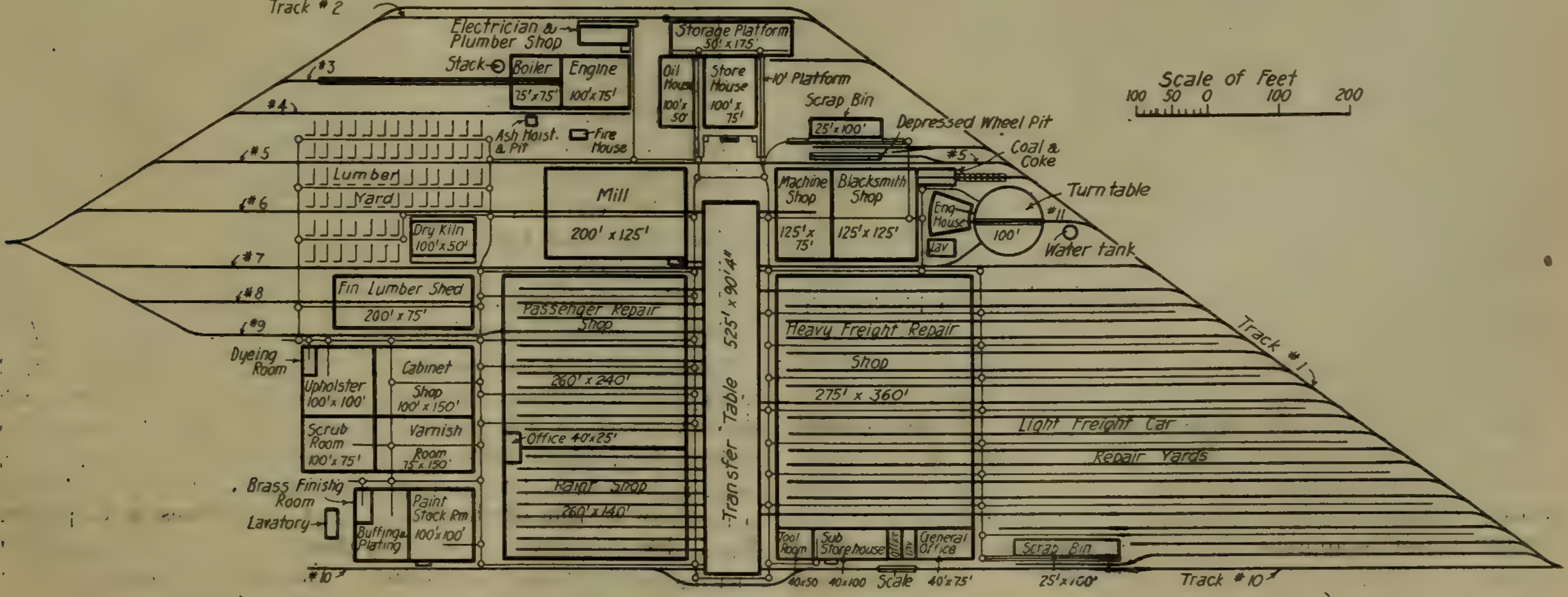
The passenger freight shop and freight repair yard should be provided with high speed ball bearing jacks for heavy cars and ratchet jacks for light jacking.

A telephone with an instrument on every foreman's desk in every department should be installed with a central switchboard.

A fire alarm system and watchman's clock system should be provided and all electric and telephone wires should be laid in tunnels or subways under the buildings.

In a shop of this size, four fire companies should be organized and drilled at least once each month so that in case of fire they are all trained and know just what to do. Each company should consist of six men.

Fire hydrants should be placed in shop yards about 300 feet apart. Inside of the buildings there should be fire hose connections every 200 feet of building in length.



Proposed Shop Layout by R. C. Bundy.

The power plant should be equipped with 1500-horsepower boilers, 150 pounds pressure, built for the fuel most plentiful in the location where shops are built. Coal for boilers should be run up an incline and dumped from cars into hoppers or bins in the boiler room and let down by gravity as it is needed. The boiler room should also be provided with two feed water pumps, one feed water heater, water softening system, if necessary, in case of bad water, and also one ash hoist. The switchboard should be of the usual design for the control of all lighting and power feeders and should be elevated about eight feet from the floor of the power house.

The engine room should be equipped with three alternating current generators, turbine or engine-driven, one synchronous motor, two D. C. generators, and one steam exciter, one large and one small compound air compressor with a capacity of 1200 cubic feet of air per minute, two condenser pumps, one live steam heater, one exhaust steam heater, one intercooler for each of the compressors, and two fire pumps with a capacity of 1500 gallons per minute, one oil pump and one oil separator.

The wood mill should be equipped with a blower system for carrying off shavings and should be piped direct to the power house. The following machinery should be installed:

1 large 4 side planer.
1 small 4 side planer.
1 large cut off saw.
1 small cut off saw.
1 band resaw.
1 large planer and matcher.
1 small planer and matcher.
1 moulding machine.
1 large rip saw.
2 small rip saws.
1 swing saw.
1 sill tenoning machine.
1 large five-spindle boring machine.
1 gainer and boring machine.
1 hollow chisel mortising machine.
1 small planer.
1 planer knife grinder.
1 circular saw grinder.
1 emery wheel.
1 circular saw setting machine.
1 band saw filer and setting machine.

The following machinery should be installed in the machine shop:

2 lathes.
3 six-spindle nut tappers.
1 tire lathe.
1 radial drill press.
3 single spindle drill presses.
3 double head bolt cutters, 1½".
1 double head bolt cutter, 2½".
1 shaper.
1 journal box lathe.
1 twist drill grinder.
1 emery wheel.
1 wheel press.
2 wheel borers.
4 axle lathes.
1 small punch.

The following machinery should be installed in the blacksmith shop:

1 large punch and shears.
2 Bradley hammers.
1 small punch and shears.
1 large bulldozer.
3 small bulldozers (air).
1 steam hammer (1500 lbs.).
1 alligator shears.
1 emery wheel.
3 bolt heading machines.
1 3" forging or upsetting machine.
1 drill press.
20 forges.
1 face plate.
1 crane for large steam hammer.

The following machinery should be installed in the tin and pipe shop:

1 pipe threading machine, R. & L.
1 test rack.
1 angle cock grinder.
1 air hose fitting up table.
1 steam hose fitting up table.
1 extra heavy squaring machine, 42" long to cut No. 16 iron.
1 42" folding machine.
1 bevel square and circular shears.
1 combined punch and shears.
1 slip roll forming machine.
1 beading machine.
2 hollow mandrel stakes.

The following machinery should be installed in the cabinet shop:

1 band saw.
1 jointer.
1 planer.
1 two-spindle boring machine.
1 rip saw.
1 cutoff saw.

The following machinery should be installed in the upholstering shop:

1 cushion beater.
1 brush for seats and backs.
3 sewing machines.
Rack to hold 2,000 backs and seats.

The following should be installed in the door shop for freight yard and shop:

1 cut off saw.
1 rip saw.
1 swing saw.
1 boring machine (small).

The following should be installed in the coupler and brake beam shop:

1 shears.
1 furnace.
2 pneumatic riveters.
1 drill press.
3 forges.
1 small crane.

The following should be installed in the buffing room:

3 electric buffing machines.
1 baking oven.
1 silver plating tank.
1 copper plate tank.
1 nickel plating tank.
1 oxidizing tank.
1 acid tank.
3 hot and cold water tanks.

The store house should be equipped with the following:

1 electric elevator.
1 electric crane (stationary).
1 track scale.
1 1500 pound scale.
1 small portable electric crane.

The method of handling the work in the passenger shop would be as follows: Passenger cars should be taken in shop on track nine as shown in the illustration, stopping them just opposite cabinet shop, where they should be stripped of all sash, doors, seats, and backs and brass trimmings, doors and sash being sent to scrub room, cushion and backs to upholstering shop and trimmings to buffing room. After cars have been stripped they should then be moved into the car shop when they should be washed inside and outside. This track should be provided with hot and

cold water for this purpose and the concrete floor pitched to sewer in the center of track. After cars have been washed, they may be pulled out on the table and set in on any track desired where they should be jacked and the trucks removed and careful inspection made to trucks and body by foreman or general foreman and all necessary work decided upon. When such repairs have been made the cars should be placed on their trucks and moved to the paint shop for paint and varnish. After the work is completed they should be trimmed and again moved to track ten where they should have floors painted the second coat and put on steam over night. The following day seat cushions can be placed in them and they may then go into service.

It is understood that while the cars are being repaired and painted, the sash, seats and trimmings are also being done, so they will all be ready when the car is trimmed. It must also be understood that all cars coming in the shop are inspected by the general foreman, who classifies the repairs and sets a date when cars are supposed to be ready for service. A blackboard should be provided for each shop, showing the car numbers, date in, and date out and kind of repairs. The dates showing cars out should be adjusted as occasion may require as they are bound to vary to some extent.

In the handling of freight cars it is good practice to have the switching done during the night in order not to delay the men and also to avoid accidents. Cars should be inspected during the day and carded to the tracks where they are wanted and a list furnished the switchmen, showing cars to be switched out and cars to be set in. Care should be exercised to get cars of as near the same class of repairs on each track in order to avoid delays. All cars, both heavy and light, to be inspected carefully and all work marked on a work card and tacked on the side of the car. The card will show the workman the repairs wanted. Any repair needed that might be missed by the inspector may be placed on the card by the foreman in charge. After repairs have been made, the card should be removed by a competent inspector who will inspect all work and see that it is properly done and check off each item. In case any work is not properly done he calls the workman back who did the work to finish it, after which the card will be turned in by the inspector to the office.

Shop should be operated on a piece-work basis, figuring on a schedule allowing the men to make about 25 per cent above the day rate. This is more satisfactory to the men and also to the railroad. However, it means constant and never ceasing watchfulness on the part of the foremen and inspectors to see that the work is well done.

The necessary force to operate a plant of the size shown in the illustration would be one general foreman, one coach foreman, one truck foreman, one foreman of inside finishing, trimming, and stripping, one cabinet shop foreman, one upholstering foreman, one mill foreman, one pipe fitting foreman, one paint shop foreman, and assistant, one foreman in varnish room, and four piece-work inspectors or checkers. All the above for passenger car work.

In the freight shop the organization should consist of two foremen and two piece-work checkers in heavy repair shop. In the light repair yard there should be two foremen and four inspectors, one foreman in machine shop and one foreman in blacksmith shop. The necessary clerical force would also have to be provided for.

The Texas Railroad Commission has decided not to order any material reductions in freight rates at this time, owing to the great losses from flood damages recently suffered by the roads.

Chairman Elliott and other New Haven directors believe they have formulated plans which will conserve the company's interest in the Boston & Maine, and at the same time satisfy the Department of Justice. This would prevent the sacrifice of the stock on the market in its present bad condition, which is a matter of the greatest importance to both roads as the New Haven has an investment in the Boston & Maine of about $30,000,000.

ELECTRIC LOCOMOTIVE EQUIPMENT DESIGN.

Since the electric locomotive is becoming more and more each day a profitable revenue producer for electric railways, it is important that a locomotive be laid out so that its equipment is easily accessible for inspection and maintenance, thus aiding in insuring reliable operation and continuity of service.

In the design of a locomotive equipment, four essential points should be kept in mind, namely—

First—To select such apparatus as will meet the conditions under which the locomotive is to operate.

Second—To mount the apparatus on the locomotive in such a way that each part will operate to the best advantage and with the least chance of trouble.

Third—To arrange the apparatus so as to give easy access to all parts and especially to those parts which are most likely to require attention.

Fourth—To mount the apparatus in such a way as not to require unnecessary expense for equipping and maintaining.

To accomplish the above outlined important factors entering into the design of a complete locomotive, standard Baldwin-Westinghouse locomotives have incorporated in them some valuable constructional features which are outlined below.

All of the main circuit-control apparatus and the resistors are mounted in the center of the locomotive and surrounded with suitable expanded metal screens as a protection against accidental contact.

In the right-hand corners of the cab are mounted the master controller, engineer's brake valve and the sander valves. These locomotives are designed for double end operation. The general scheme of arrangement is shown in the illustration.

It will be noted that the reversers or series-parallel switches are placed next to the floor, the switch groups and line switches directly over them, and the resistors directly over the switch groups under the roof.

The grid resistors are mounted in the main cab over the switch groups, partly on account of simplified wiring and partly because there is not sufficient room underneath the locomotive between the trucks to accommodate them when considerable capacity is required. The resistors are enclosed in a steel cabinet open at the bottom and provided with hinged doors on each side so as to provide easy access.

Ventilators are provided in the roof over the resistance cabinet of such a type as to give free egress to the heated air and to prevent rain from entering.

The space occupied by the apparatus under the resistance is enclosed by grounded expanded metal screens which are made up in sufficiently small sections so that they can readily be removed for the inspection of the apparatus.

When forced ventilation is required a centrifugal motor-driven blower is installed in one or both of the hoods with the air compressor. These blowers force air through a conduit built into the locomotive frame between the center sills from whence it passes to the main motors through flexible canvas connections.

The traction motors for propelling the locomotive are mounted in the usual manner, using nose or cross-bar suspension.

The advantages of this centralized arrangement may be briefly summed up as follows:

First—All the control apparatus is assembled compactly in one part of the locomotive instead of being scattered in different locations.

Second—The switch groups are located in such a position that they are readily accessible from all sides and they are at such a height that a man can get at them freely without working in a cramped position, or inside the hood.

Third—The resistors being located above the switch groups under the roof reduces the length of connections between the two pieces of apparatus to a minimum and at the same time the heat rising from the resistors passes directly out through ventilators in the locomotive roof and a very little of it reaches the switch groups.

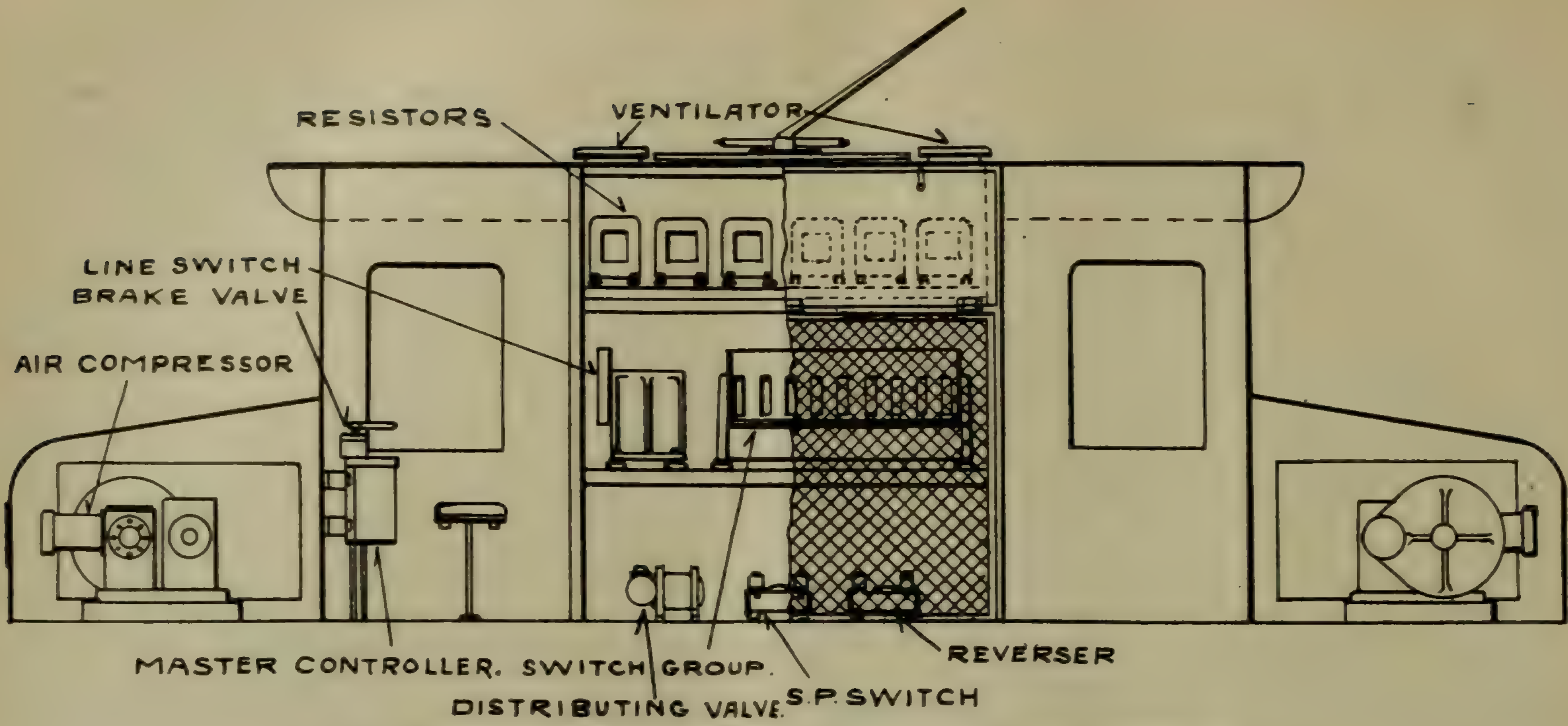


Fig. 1—Side Elevation Standard Baldwin-Westinghouse Electric Locomotive.

Fourth—The reversers are mounted in a position where they can be readily gotten at and at the same time they are centrally located relative to the motors and near enough to them so that the amount of cable required is reasonable.

Fifth—The airbrake distributing valve is located inside the cab, where it will be kept sufficiently warm to prevent freezing and where at the same time it is easily accessible.

Sixth—The location of the compressor and blower motor in the hood removes the feature of objectionable noise inside the cab, and at the same time locates them in a position where they can be easily lifted out by merely taking off the hood without disturbing any other apparatus.

Seventh—The motorman is located in a position where he has a clear view of the track.

HANDY TOOL WAGON FOR THERMIT WORK.

The illustrations herewith show a particularly useful tool wagon now in use by one of the railroad shops of the middle West and which was designed and built especially for the apparatus used in Thermit welding.

It contains a receptacle to hold the crucible, a tool box for all the necessary tools used in Thermit welding, space for several mold boxes for different frame sections, and a box for molding material divided into two parts. In the top is kept the special molding material for facing, while in the lower part the mixture of sand and fire clay used for backing.


Thermit Tool Wagon Showing Compartments for Holding Molding Materials.


Receptacle for Holding Crucible and Tool Box for Keeping Miscellaneous Appliances.

It will be noticed from the illustrations that a sand screen is provided in the lower half of the lid and this is used for screening the molding material when a mold is being broken up so as to prepare it for the next weld. During the screening of sand this lid is kept closed.

This wagon keeps all material off the floor and makes it easy to transport everything from one place to another. It also saves a great deal of time and labor in the preparation of molding material. In a great many shops it is the custom to mix new molding material for each weld as there is no convenient way of saving the old material. It will readily be seen that with a wagon like this a great deal of such labor is done away with. This wagon is 27" wide, 57" high to top of tool cupboard and its length exclusive of the handle is 7 feet.

The plan under consideration calls for a voluntary trust, approved by the Federal and State governments, to take over the New Haven's controlling interest in the Boston Railroad Holding Co., owner of a majority of the Boston & Maine stock. The trust would cover a period of 10 years or more, at the end of which the stock would be sold and the proceeds distributed pro rata among the New Haven stockholders.

GAUGE FOR SETTING ECCENTRICS.

By Alden B. Lawson.

All shop men realize the great amount of trouble experienced in placing accurately the keyway locations in the driving axle for the eccentrics. Quite frequently it is necessary to use offset keys to correct inaccuracies, caused in transferring the center line of crankpin to axle.

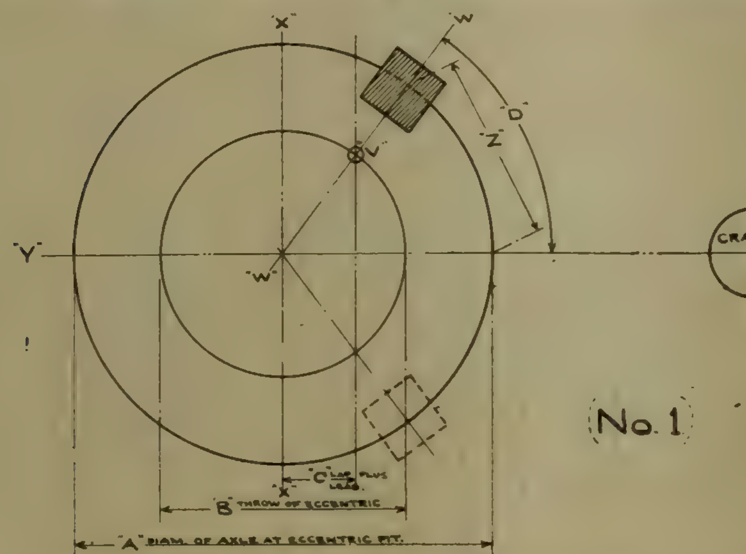
To overcome this to a considerable extent and insure proper locations, gauges have been adopted, with a view of enabling the shopman to obtain these locations with the least possible chance of mistake on his part. The writer will describe these gauges.

The valve lap and lead are the first necessary elements, and as this is gradually standardized by experience on various classes, to suit each class of locomotive, the other work for obtaining the keyway location is simple. Referring to figure 1 the rules for obtaining the location are as follows: To obtain eccentric keyway location in main driving axle when using Stephenson valve gear (dimension "Z" or degree "D" in the diagram) a full size drawing should be used. Lay down a circle whose diameter equals the outside diameter of driving axle at eccentric fit per dimension "A." Lay down another circle representing eccentric throw from same center, as per dimension "B."

Draw horizontal center line "Y"—"Y" through center of axle and vertical center line "X"—"X" also through center of axle.

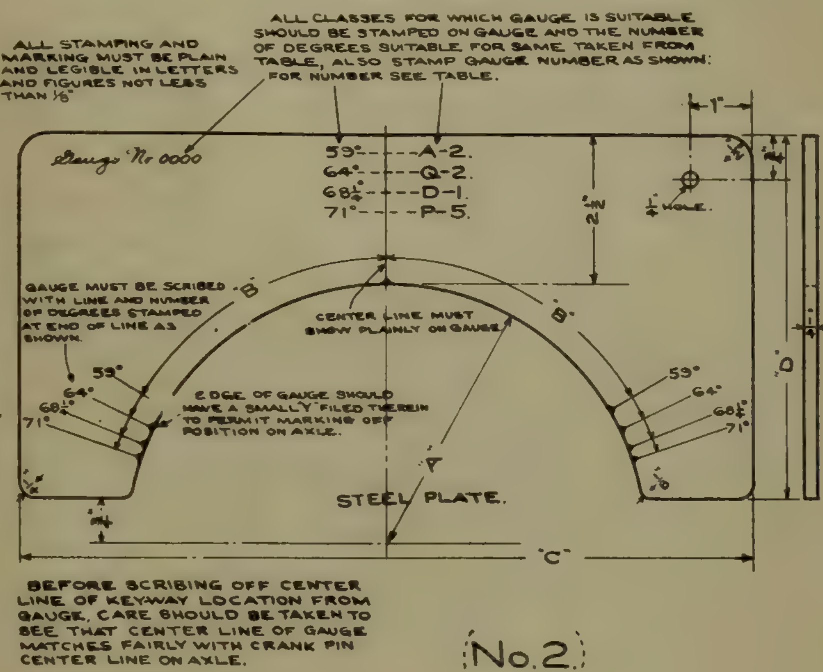
Then lay off from the vertical center line "X"—"X," on horizontal center line "Y"—"Y," the amount of lap plus lead of valve. This is modified by the rocker, due to the different lengths of arms. Draw a vertical line to intersect the circle representing the eccentric throw, indicating point "V."

Then from the center or intersection of center lines "Y"—"Y" and "X"—"X" draw line "W"—"W" through "V," the point where the vertical line crosses the circle "B," and extend this line so as to intersect the larger circle "A," which



LINE No.	CLASS OF LOCOMOTIVE	LAP	LEAD	"A"	"B"	GAUGE No. FOR KEY WAY LOCATION.	TYPE OF VALVE. SLIDE	TYPE OF VALVE. PISTON	LENGTH OF ROCKER ARM. VALVE END	LENGTH OF ROCKER ARM. ECC. END	"C"	ANGLE OF ADVANCE	LOCATION OF ℄ OF ECC. KEYWAY. DIMENSION "Z"	LOCATION OF ℄ OF ECC. KEYWAY. DEGREE "D"
1	A-1, C-5	1 1/4"	1/16"	8 1/2"	5"	1001	YES	—	13 1/8	11 3/32	1 3/32	31°	4 3/16	59°
2	A-2.	1 1/2"	1/16"	9"	5"	1002	YES	—	11"	9 1/8"	1 9/32"	31°	4 7/16	59°
3	A-3	7/8"	1/16"	7"	5"	1003	YES	—	10 1/2"	10 1/2"	15/16"	22°	3 23/32"	58°
4	A-4	1"	1/16"	8"	5 1/2"	1004	YES	—	11 3/4"	11 3/4"	1 1/16"	22 3/4°	4 7/16"	57 1/4°
5	A-5	1"	1/16"	8 1/4"	5 1/2"	1005	YES	—	11 3/4"	11 1/8"	1"	21 1/2"	4 21/32"	68 1/2°
6	B-1, B-2.	7/8"	1/16"	8"	5 1/2"	1006	YES	—	10 7/8"	10 7/8"	15/16"	20°	4 3/16"	70°
7	B-3.	3/4"	1/16"	7"	5"	1003	YES	—	11"	11"	13/16"	19°	4 1/16	71°
8	B-4, B-5	3/4"	1/16"	8"	5"	1004	YES	—	11"	11"	13/16"	19°	4 21/32	71°
9	C-1, C-2	1 1/4"	1/16"	8 1/8"	5 1/2"	1007	YES	—	11 5/8"	11"	1 1/4"	27°	4 1/4"	63°
10	C-3	3/4"	1/16"	7 1/8"	5"	1008	YES	—	11"	11"	13/16"	19°	4 1/8"	71°
11	C-4.	1"	1/16"	9"	5 1/2"	1009	YES	—	14"	12 27/32"	31/32"	21°	5 1/8"	69°
12	D-1	1"	1/16"	9"	5 3/4"	1002	YES	—	11 3/4"	11 3/4"	1 1/16"	21 3/4°	5 1/16	68 1/4°
13	D-2	1"	1/16"	8 1/2"	5"	1010	YES	—	13"	11 13/16"	31/32"	23°	4 11/16"	67°
14	D-3.	3/4"	1/16"	7 1/8"	5"	1008	YES	—	11"	11"	13/16"	19°	4 1/8"	71°
15	D-4	3/4"	3/32"	8"	5"	1006	YES	—	10 3/16"	10 3/16"	27/32"	20°	4 19/32"	70°
16	D-5, E-1.	3/4"	3/32"	8 5/8"	5"	1011	YES	—	11 1/8"	10 1/4"	25/32"	18 1/2°	5 1/16"	71 1/2°
17	E-2.	3/4"	3/32"	7 1/8"	5"	1012	YES	—	11"	11"	27/32"	20°	4 3/32"	70°
18	E-3	3/4"	1/16"	6 3/4"	5 1/2"	1013	YES	—	10 1/4"	9 1/4"	47/64"	16°	4 3/32"	74°
19	E-4, E-5	1"	1/16"	7 1/2"	5 1/2"	1014	YES	—	11"	10"	31/32"	20 1/2°	4 9/32"	69 1/2°
20	H-1	1"	1/16"	7 1/2"	5"	1015	YES	—	10 1/2"	9 1/2"	31/32"	23°	4 5/32"	67°
21	H-2, H-3, H-4. WITH 7 1/2" AXLE	1"	1/16"	7 1/2"	5 1/2"	1015	YES	—	11 1/8"	10"	61/64"	20°	4 5/16"	70°
22	H-2 H-3, H-4 WITH 8" AXLE	1"	1/16"	8"	5 1/2"	1006	YES	—	11 1/8"	10"	61/64"	20°	4 9/16"	70°
23	H-5	1"	1/16"	8 1/2"	5 3/4"	1001	YES	—	12 3/4"	12"	1"	20 1/2°	4 27/32"	69 1/2°
24	O-1 (1 1/4"x19" PORTS)	1"	1/16"	9"	5"	1009	YES	—	12"	12"	1 1/16"	25 1/4°	4 13/16"	64 3/4°
25	O-1 (1 1/2"x20" PORTS)	7/8"	1/16"	9"	5"	1016	YES	—	12 1/8"	11 3/8"	7/8"	20 1/2°	5 1/8"	69 1/2°
26	O-2	1"	1/16"	8 5/8"	5 1/2"	1011	YES	—	11 1/2"	10 3/4"	1"	21°	4 7/8"	69°
27	O-3, O-4	7/8"	1/16"	9"	5 3/4"	1016	YES	—	12 1/8"	11 3/8"	7/8"	17 1/2°	5 5/16"	72 1/2°
28	O-5, P-1, P-2	7/8"	1/16"	9"	5 3/4"	1009	YES	—	12 1/4"	11 3/4"	29/32"	18 1/2°	5 9/32"	71 1/2°
29	P-3, P-4	3/4"	1/16"	8 1/2"	5"	1010	YES	—	11"	11"	13/16"	19°	4 15/16"	71°
30	P-5.	3/4"	1/16"	9"	5"	1002	YES	—	11 1/2"	11 1/2"	13/16"	19°	5 7/32"	71°
31	Q-1	7/8"	1/16"	9"	6"	1009	—	YES	10 1/2"	10 1/2"	15/16"	18 1/2°	5 1/4"	71 1/2°
32	Q-2	1 1/4"	1/16"	9"	5 1/2"	1002	YES	—	13 1/4"	12 1/8"	1 3/16"	26°	4 25/32"	64°
33	Q-3.	7/8"	1/16"	8 1/2"	5"	1001	YES	—	12 1/4"	10 1/2"	13/16"	19°	4 15/16"	71°
34	Q-4	1 1/4"	1/16"	9 1/2"	5 1/2"	1017	YES	—	13 1/2"	12"	1 11/64"	25 1/2°	5 1/16"	64 1/2°
35	Q-5. FORWARD MOTION.	1"	1/16"	9 1/2"	5 1/2"	1017	—	YES	10"	9"	61/64"	20 1/2°	5 7/16"	69 1/2°
36	Q-5. BACKWARD MOTION.	1"	1/16"	9 1/2"	5 1/2"	1017	—	YES	10"	9"	27/32"	18°	5 19/32"	72°

Fig. 1.



LINE No.	CLASS OF LOCOMOTIVE.	GAUGE NUMBER	"A"	"B" DEGREES	"C"	"D"
1	E-3	1013	3 3/8"	74°	10 1/4"	5 1/8"
2	A-3.	1003	3 1/2"	58°	10 1/2"	5 1/4"
3	B-3			71°		
4	C-3, D-3.	1008	3 9/16"	71°	10 3/8"	5 5/16"
5	E-2.	1012	3 9/16"	70°	10 5/8"	5 3/16"
6	H-1.	1015	3 3/4"	67°	11"	5 1/2"
7	H-2, H-3, H-4.			70°		
8	E-4, E-5.	1014	3 3/4"	69 1/2°	11"	5 1/2"
9	A-4.	1004	4"	57 1/4°	11 1/2"	5 3/4"
10	B-4, B-5.			71°		
11	B-1, B-2, D-4, H-2, H-3, H-4.	1006	4"	70°	11 1/2"	5 3/4"
12	C-1, C-2.	1007	4 1/16"	63°	11 5/8"	5 13/16"
13	A-5.	1005	4 1/8"	68 1/2°	11 3/4"	5 7/8"
14	A-1, C-5.	1001	4 1/4"	59°	12"	6"
15	H-5.			69 1/2°		
16	Q-3.			71°		
17	D-2.	1010	4 1/4"	67°	12"	6"
18	P-3, P-4.			71°		
19	D-5, E-1.	1011	4 5/16"	71 1/2°	12 1/8"	6 1/16"
20	O-2.			69°		
21	A-2.	1002	4 1/2"	59°	12 1/2"	6 1/4"
22	Q-2.			64°		
23	D-1.			68 1/4°		
24	P-5.			71°		
25	O-1, 1 1/4"X19" PORTS.	1009	4 1/2"	64 3/4°	12 1/2"	6 1/4"
26	C-4.			69°		
27	O-5, P-1, P-2, Q-1			71 1/2°		
28	O-1, 1 1/2"X20" PORTS	1016	4 1/2"	69 1/2°	12 1/2"	6 1/4"
29	O-3, O-4.			72 1/2°		
30	Q-4.	1017	4 3/4"	64 1/2°	13"	6 1/2"
31	Q-5. FORWARD MOTION.			69 1/2°		
32	Q-5. BACKWARD MOTION.			72°		

Fig. 2.

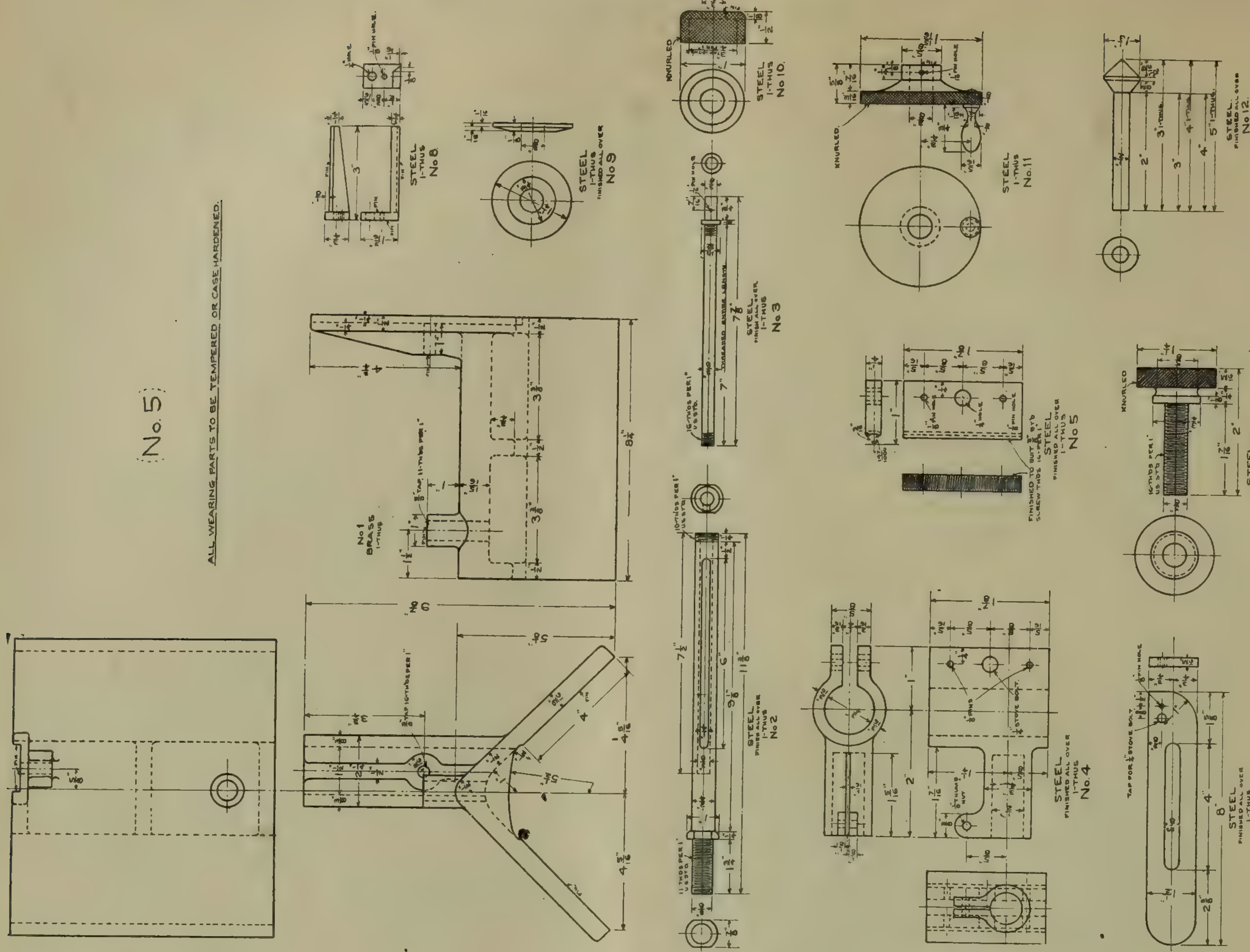


Fig. 5.

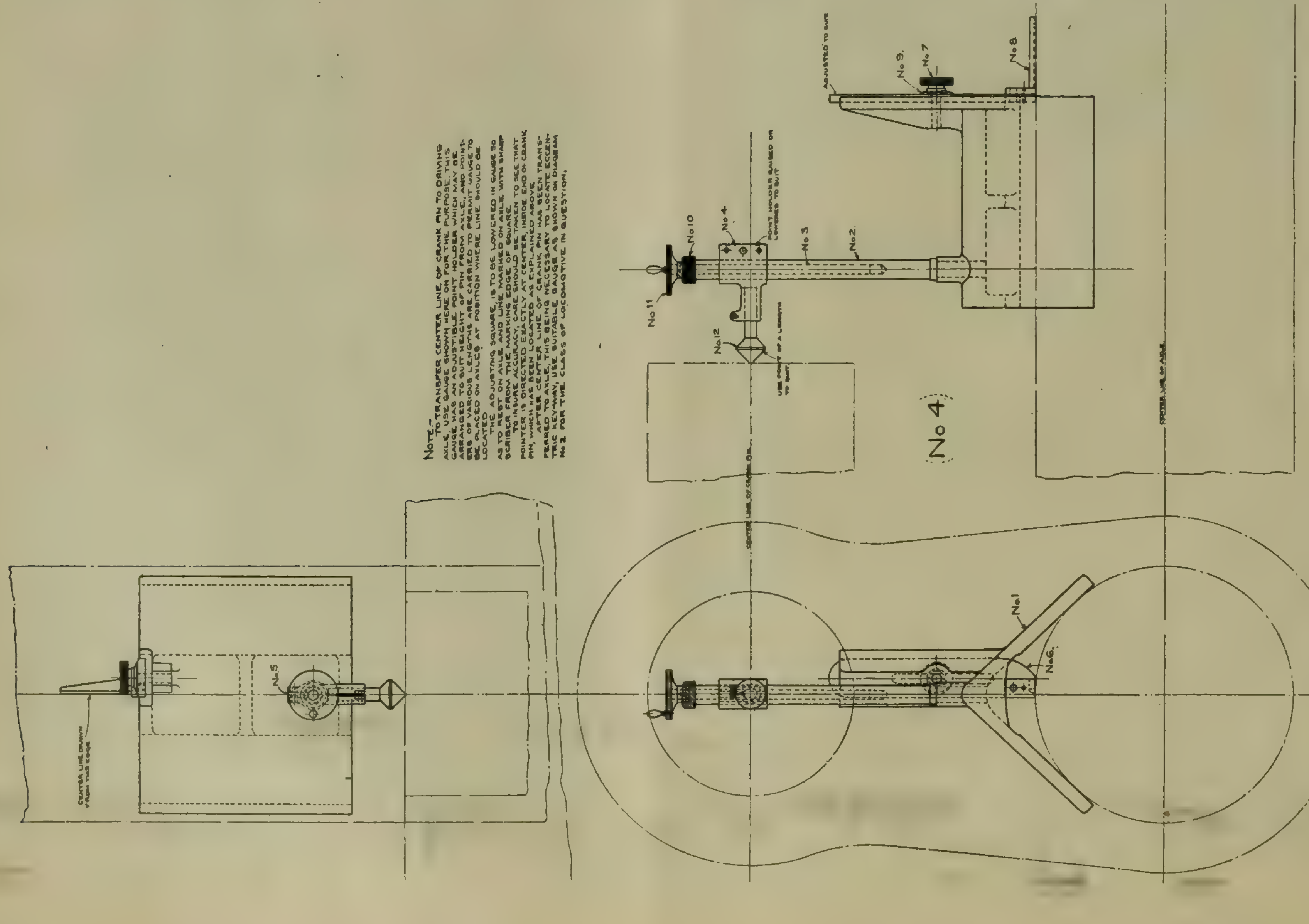


Fig. 4.

will represent the point on circle "A," where the center of keyway should be and give the dimension "Z" and degrees "D," which should be used.

The gauge for transferring center of crank to axle on locomotive with Stephenson gear, is shown in figure 2.

Before using the gauge, care should be taken to obtain first the center of crank. In machining up the main crankpin there should be a proof circle turned on the inner edge, and from this the shopman may form four center punch marks equally spaced on this circle, obtaining the accurate center of crank with his dividers. The turning hole in end of crank should be filled with

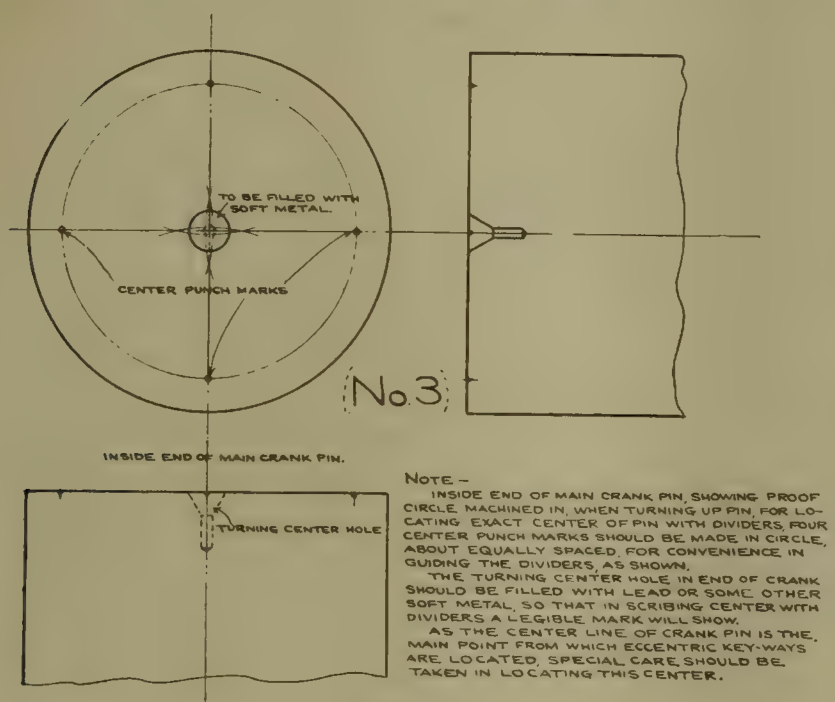


Fig. 3.

soft metal so as to permit of marking with the point of dividers, as shown in figure 3.

After the exact center of the crank is obtained, the gauge for transcribing this center to the axle is used. The gauge is adjustable and should be of a size to use on all crank arms. It will, however, be found advisable to have various lengths of pointers. The transcribing plate is also adjustable and will suit all size axles.

After the center is scribed on axle, templet per No. 2 is used, the center "O" on this templet is placed exactly on center line on axle and the distance or degrees for keyway center line is scribed on axle.

Each gauge is marked for the class of locomotives for which it is suitable, also giving the diagrams of keyway location for each class used.

It will be found necessary to have at least one gauge for each diameter of axle, and where there are various classes using the same diameter axle, it may be necessary to make two or more gauges. This is necessary where two markings are so close together as to cause one marking to interfere with the other. However, it will be found that the gauge will usually care for several classes of locomotives.

The gauges are given a standard gauge number, and the print is tabulated to show gauge number as well as classes for which suitable.

With this information worked up in the drawing office, and templets made as shown in the illustrations, unnecessary responsibility has been taken from the shopman. Also less work will be required and better results obtained than if gauges are not used.

An appropriation of $40,000,000 is being sought by the Russian Ministry of Ways of Communication, St. Petersburg, for the repair shops of the government railways, which will make them virtually large locomotive and car works.

The New York Central & Hudson River has let a contract to F. I. Ley & Co., Springfield, Mass., for the erection of a new station at White Plains, N. Y.

THE GENERAL FOREMEN'S ASSOCIATION.

Every effort is being made by officers and members of the General Foremen's Association to make the next convention, to be held in Chicago July 14, 15, 16 and 17, 1914, the most successful in point of attendance ever held by this rapidly growing organization. The superintendent of motive power and the master mechanic of today is looking to his general and shop foremen to work out the details of shop and roundhouse management in order that he may develop his talents along the lines of operation, which in the past has been handled exclusively by the transportation officials.

The mechanical railway official who does not take advantage of his position and inquire and keep posted on matters other than those of a mechanical nature, soon watches the procession pass him. Consequently the general and shop foremen are taking over many of the shop duties and responsibilities formerly handled by superintendents of motive power and master mechanics.

The General Foremen's Association has within its membership the men who are continually on the firing line of mechanical progress. The papers read and discussed are worth a great deal to the railway company who sends able representatives to the meetings. Every superintendent of motive power and master mechanic should have in his possesion a copy of the proceedings of the last General Foremen's Convention, and should ask to have his name placed on the mailing list of the secretary in order that he may have mailed to him a copy of the last and future proceedings of their convention. The secretary, Wm. Hall, 829 W. Broadway, Winona, Minn., will gladly send a copy to any official who desires one.

The subjects for the 1914 convention are as follows:

1. Engine-house efficiency.
2. Cylinders, pistons, cross-heads, guides and valves.
3. The practice and methods of maintenance and repairs to the airbrake and its appurtenances.
4. Autogeneous welding.

Subsidiary papers:

1. The Taylor system.
2. Railroading at a high altitude, by J. W. Scott, locomotive superintendent, Southern Railway of Peru, La Paz, Bolivia.

MAN FAILURE.

The engine may fail and the track may wear,
There are metal and tools to remake and repair;
The target may break and the switch go wrong,
But a bolt and a blow will help them along;
When men fail the system is crippled all through—
Man Failure, that's where the doom points at you.

Ties may wear out and tie-bolts may rust,
That is a matter repair gangs adjust;
Pistons may rattle and valves spring a leak,
The doom of the system's when men have grown weak,
When men fail to answer with thoroughness keen—
Man Failure, that's where you lose the machine!

As the strength of the chain is the strength of each link,
You cannot move earth if the men fail to think;
If the men fail to measure each moment of life
Right up to the keenest demand of the strife;
If men fail to master with soul and with brain—
Man Failure, that's where you throw off the train.

—*Baltimore Sun.*

The Cincinnati, New Orleans & Texas Pacific is to begin the erection in Chattanooga, Tenn., in the near future, of a reinforced concrete building in which will be located the main paint and repair shops for the passenger coaches of the company. The shops will have a capacity of twelve passenger coaches a month. The building will be erected on the present site.

WHEEL SLIDING.

By W. L. FRENCH.

While wheel sliding occurs at any season of the year it most commonly happens during the winter months, and for which there are several contributory causes in the way of leaks in hose couplings due to stiff hose, sluggish acting triple valves and brake shoes frozen to the wheels. It takes but a small amount of moisture applied at the right time and place to freeze a shoe to a wheel, whereupon it will slide until it is ruined unless some watchful one detects the trouble and releases it.

A little snow on top of the brake shoe becoming melted by frictional heat drips down between the shoe and wheel, and while the train is at rest clamps them fast together. An overflow of the tank, either around the tank valves or at the man-hole, or water running out of open seams in the tank supply spout striking the wheels of the tender causes them to freeze fast to the brake shoes, and if no one is looking for this trouble more wheels are spoiled.

The train pulls hard anyway and the boxes freeze up, so the engineer expects and does have trouble starting the train. He is not in a position to tell if wheels are sliding.

The conductor, after he delivers orders to the engineer as the train pulls by him, can readily see if any wheels are not turning and he also is able to observe if any brake rigging is down or drawbars ready to pull out, and bad leaks in the hose couplings will make themselves heard as well as felt when the slack is taken out of the train.

If the conductor is not in a position to note these things one of the brakemen should, for it is easier to do this, and to detect and remedy troubles than it is to tell why they were not found until damage was done. Some wheels are slid flat when coming into town, but more, many more, are slid flat in getting out of town than in coming into it.

A hand brake set and overlooked is another cause of slid flat wheels, and this is one of the cases that is wholly unnecessary. Gummed up leakage grooves, leaky triple piston packing rings, brake shoes frozen to the wheels and an overcharged train line are the prime causes of slid flat wheels.

If a leakage groove is corroded up, that brake may have a leak that will cause it to creep on harder and harder until wheels slide.

A leaky triple piston packing ring allows but a small margin for release between the two pressures, and when a release is made it may not let go at all. On a short train this kind of a brake can usually be released by raising the train line pressure quickly; on a long train it can not be counted on to do this with as much certainty, but when a high excess pressure is carried it may be accomplished by the quick release and return to running position, this quick release acting as a sort of blow to the triples.

If it is discovered by the engineer that a brake is sticking, and the black hand registers 70 pounds, he should not try to kick it off, as by so doing the one sticking will be released only temporarily, if at all, and will immediately reset and cause others to apply.

If on the level or a descending grade the brakes should be applied with a good reduction and then released, which will nearly always cure the trouble. If on a grade where this can not be done, put the brake valve handle in full release and leave it there until over the hill, then made a reduction, more if needed, and pull the train line pressure down to where it belongs and release brakes.

Overcharging is more liable to occur with a short train of any length if brake valve handle is left long enough in full release position.

If the brakes are not handled properly the engineer may get the train over the hill and go down the other side with the grade in his favor, but there will likely be flat wheels when the stop at the bottom is made as well as explantory reports to make. Care and watchfulness by everyone in charge can avoid many flat wheels, and wheels cost money.

The first cost of new wheels is considerable, and when to this is added the cost of changing them, no wonder severe complaint is made by officials when wheels are flattened pretty regularly. Then there is the danger and expense incident to broken rails, frogs and railroad crossings. A wreck from one of these causes might result in damage amounting to thousands of dollars besides a possible loss of life.

If the wheels flattened are of cast iron and are flattened to the extent of 2½ inches or more they must go in the scrap pile and new ones replace them. This applies to freight service. One-half that amount of flat surface on a wheel renders it useless in passenger service. If the wheels are steel tired and the tires are not thin they may be turned down and returned to service, but even then it costs money and the life of the tire is shortened that much. Wheels of cast iron with only a small flat spot on them may be turned, but the burned iron around the flat spot soon shatters and shells out, and such wheels have to be removed eventually.

In the winter it is a good plan for the men on the engine to watch their tank wheels after making a stop and see that all are turning, and more especially so after taking a tank of water or running through heavy snow with brakes applied.

The brakes should be released when a full stop has been made and the angle cock at the rear of the tender should not be closed by the brakeman until the engineer has had time to release the brakes after stopping, and he should not forget to do it. The brakes will re-apply in a short time from train line leaking, but the equalization will be at a lower pressure and will therefore be the easier to release when engine is again attached to the train. The best way to release the brakes after engine has been separated from the train is to shoot the excess pressure back into the train, come to running position and let the train line pressure raise to 50 pounds, go to lap and get full excess, then go to full release and back to running position. This ought to release any or all brakes on the train. When the gauge shows 60 pounds on train line with brake valve handle in running position the train may be started without danger of pulling out a drawbar at that high equalization.

With the brake valve handle in full release position the head end of a long train may have 60 pounds pressure, and the black hand register it, while the pressure at the rear end of the train may be much lower and thus afford an excellent chance for drawbar trouble.

The second release should be quick and heavy to give good results; that is why a full head of excess pressure should be pumped up before it is made, and any brakes on the head end inclined to reset after the first release will be kicked off for good.

The danger of sliding wheels on account of slippery rails is nearly always in the winter, but this can be overcome by the judicious use of sand. If they should slide on a slippery rail, it is not so injurious in the same period of time as it would be on a dry rail, but should they start sliding before sand was applied to the rail they would be flattened very quickly.

Small flat spots on drivers or tank wheels should be ground out with the brake itself and the judicious use of a little sand. If the sand supply has run out, or the wind is high and sand can can not be put on the rail, one must start to brake farther back, using a slight reduction. This will consume more time in making a stop but it will prove more satisfactory in the end.

All engineers guard against the muddy highway crossing and the mucky rail after a drizzling rain in the summer, and it is equally necessary to guard against the frosty rail of an early morning hour in the fall or the wet one of a soft winter day.

It must be admitted that light train line reductions are not a good thing when it comes to releasing the brakes properly. Make a reduction of from 10 to 15 pounds so that all brakes will apply full on, then when a release is made all brakes will let go.

The only excuse for light reductions is a bad rail and no sand, as they cause stuck brakes, stalled trains and extra work and trouble for all concerned. Bringing the train pipe pressure well below the auxiliary reservoir pressure will insure the setting of each brake that will apply at all, outside of emergency.

With a light, slow reduction the escape of air through the leak-

age groove may prevent the brake setting, particularly if it is a little slow of action, while one already stuck may apply harder.

Putting the brake valve handle in release position when the main line pressure is at the maximum will charge it above the feed valve adjustment, and as the pressure leaks off the brakes will creep on; another kick off will really be a kick on, and result in slid wheels.

If there is a leaky triple piston packing ring it charges the auxiliary without releasing the brake. A brake without any leakage of auxiliary reservoir, or a cylinder with a moderate or short piston travel is harder to release than one with a longer travel, as it sets harder and equalizes higher.

Another feature of the heavy initial reduction is that it compels each brake to do its portion of the work, so far as possible with unequal travel and does not place the burden of the stop on a few good brakes.

Poor driver and tender brakes tend to cause wheels to slide by overloading other brakes in the train. The slower the speed the more the tendency to slide the wheels, another reason why the heavy reduction should come at the commencement of the stop and the lighter one to complete it.

Several light reductions with one application brings the heavy braking power on the wheels at slow speed, when the reverse should be the case.

Ordinarily no rougher stop will be made with the heavy initial reduction than with the lighter ones.

If engine has no independent brake valve one must be governed by the train being handled and other conditions of the stop.

In passenger service with the old standard brake equipments the two-application stop is much the better. Some roads make a difference between a long and short passenger train, those having under 10 cars, two applications, while with those of 10 or more cars, but with the independent brake, two will be preferable.

With the new passenger equipment it is all changed, as instead of a graduated on stop it is a graduated off stop. In other words, a graduated release to regulate the speed of the train and bring it to a stop at the desired place. This reduces the cylinder pressure when the speed is low and lessens the danger of flat wheels.—*Locomotive Firemen and Enginemen's Magazine.*

A USEFUL DOCUMENT.

The orders of Mr. J. W. Brooks, a once celebrated American railroad manager of Michigan were, it is said, almost beyond deciphering. On a certain occasion, when a second line had been laid on one of the branch roads, it was reported at headquarters that the barn of an old farmer stood partly upon land which the company had bought, and dangerously near to passing trains. Mr. Brooks, just getting ready for a trip down the Mississippi, wrote to the farmer that he must move his barn from the company's land at once. If he delayed he would be liable to a suit for damages. The old farmer duly received the letter, and was able to make out the manager's signature, but not another word could he decipher. He took it to the village postmaster, who equally unable to translate the hieroglyphics, was unwilling to acknowledge it. "Didn't you sell a strip of land to the railroad?" he asked. "Yes." "Well, I guess this is a free pass over the road." And for over a year the farmer used the manager's letter as a pass, not one of the conductors being able to dispute his translation of the instrument.—*From Tidbits of American Humor.*

It is rumored that the Chicago, Milwaukee & St. Paul is considering the proposition of consolidating its shops now located at Savanna, Ill., and Ottumwa, Ia., and putting the shops at one place. It is rumored that they will be located at East Moline, Ill.

The Dayton, Lebanon & Cincinnati expects to spend in the neighborhood of $60,000 in improving terminal facilities in Dayton, O. A new passenger and freight depot is anticipated.

The Duluth & Iron Range has ordered 365 tons of structual steel from the American Bridge Company.

"SAFETY FIRST" ON GRAND TRUNK.

The safety committee, which is the executive body in charge of the "Safety First" movement on the Grand Trunk, held its first meeting at the general offices, Montreal, on January 12. The following members were present:

H. G. Kelley, vice-president, chairman.
U. E. Gillen, general superintendent, Chicago.
H. E. Whittenberger, general superintendent, Toronto.
C. G. Bowker, general superintendent, Montreal.
W. D. Robb, superintendent of motive power, Montreal.
H. R. Safford, chief engineer, Montreal.
T. W. Blaiklock, engineer, maintenance of way.
T. W. R. McRae, claims agent, Montreal.
George Bradshaw, safety engineer, secretary.

This was the first meeting of the committee since the organization of the safety movement. The report read by the secretary disclosed the fact that twenty-four division, shop and terminal safety committees have been organized on the system with a membership of about 600. During the month of December the members of these committees actually corrected 500 unsafe physical conditions which might perhaps have caused injury, and cautioned employees against unsafe methods and practices in about 480 cases. The general safety committee passed upon a number of important recommendations submitted by the local committees.

The report of the secretary showed the interesting fact that since the inauguration of the safety movement on the Grand Trunk on August 15, 1913, injuries to employees have been reduced to the extent of 11.5%, and that during the same period fatal injuries to employees on duty have been decreased 50%, as compared with same period of 1912. Traffic was heavier in the latter period than in the former.

The officers and employees of the Grand Trunk are taking a keen personal interest in correcting unsafe conditions and practices and to this interest is due the favorable record above cited, which is one of the most remarkable that has ever been achieved by the safety movement on any railway, and especially so in view of the short time in which the movement has been in force.

PENNSYLVANIA LUNCH CAR.

The Pennsylvania Railroad has just completed a new solid steel lunch counter car, and it has been placed in service between New York and Philadelphia, on trains which also carry ordinary dining cars. While the novelty of the counter car may for a few days prevent a fair comparison in the patronage of the two kinds of cars, it is planned to continue the experiment for a sufficient period to determine just what is more popular with the traveling public. The object in building the counter car was to see if it would permit of serving meals to passengers quicker, and thus serve satisfactorily more patrons, than is possible in a dining car. The new car is eighty feet long, and the exterior appearance is the same as that of a Pennsylvania all-steel passenger coach. The interior is radically different from the ordinary dining car. Instead of tables there is one long mahogany counter extending over half the length of the car; facing this counter on one side are revolving mahogany chairs, secured to the floor. The counter is long enough for 21 people to be seated at one time. Back of the counter against the wall there are twenty cupboards for supplies, in addition to receptacles for crushed ice, drinking water, ice cream, milk and cream. Shelves for linen and silver occupy the space under the counter. Sunk in the counter at the end away from the kitchen is a cigar humidor. At one end of the car there is a wash basin for the use of passengers.

The pantry and kitchen are at one end of the counter. The pantry contains dish racks, cupboard, a sink and a locker. Food will be passed from the kitchen into the pantry through openings which can be closed by sliding doors. As these openings are just above the serving table in the pantry, there is no necessity for waiters to go into the kitchen. The kitchen itself is about eleven

feet long; it contains a range, broilers, steam table, ice box, coffee urn, soup receptacle and meat warmer.

The interior of the car is finished in a mahogany color, the same as the dining cars. It will be electrically lighted, and ventilation will be aided by an exhaust fan and three large electric fans.

The present plan is to put the car in service on a train leaving Philadelphia for New York at 12 o'clock noon, as this train is usually heavily loaded, and a large number of the passengers as a rule eat their lunch on the train. The second trip of the car will be on the train leaving New York the same afternoon at six o'clock.

MAKING CAR MEN EFFICIENT BY VOCATIONAL INSTRUCTION.

By Louis Brentnall.

The large increase in number of car men now in railroad service over the limited number that was employed several years ago, as well as the urgent demands which are made upon the master mechanic that car work be handled efficiently, requires that car men attain the highest degree of proficiency, in order to perform their work well and economically.

It therefore goes without saying that vocational instruction is beneficial to both the company and the workmen. That it will increase the ability and capacity of the men in performing their daily duties, is beyond question. Of course, the instruction should be well planned and given systematically.

As all master mechanics or master car builders know, the men they employ differ from one another in many respects. Not all of them have the same way of working. One workman may be dexterous, doing his work with a knack that is unexplainable. He himself may not know just how he accomplishes certain results, further than that he uses a peculiar twist of the wrist. Another workman may be skilful, performing his work understandingly, and consequently he is usually called upon for special jobs, or his advice sought when some particular information is needed regarding the handling of repair work. Yet it is sometimes the case that both of these men lack greatly for the want of instruction regarding features which they do not understand, and therefore vocational instruction is needed. There are workmen who use their heads only as nightcaps and their hands as tools, performing their duties as though half asleep, but where these fellows are shown how to use their heads along with their hands they may become as proficient as other workmen. Primarily, a workman may be somewhat dexterous, possess some skill, and endeavor to do his best, but in order to make him expert in his work he requires instructions from an expert workman or instructor.

The oldtime plan of driving men, or finding fault with their operations when not up to standard, was a disappointment to most workmen, who, after trying to do their best, such as it was, were censured for doing it, on account of some little flaw being discovered in their handiwork after they had finished a job. The modern way is to give a man credit for what he knows or does and at the same time increase his efficiency by instruction.

A main, or large repair shop, is the best place to instruct car men in approved ways of working. The actual work should be set out before the workmen and the men put to work on the operations necessary to do the work. As the work proceeds, the instructor gives the men special pointers regarding the details, answers any questions that may be asked, and tells the men why the work is best handled in the way he teaches. Old employes who have been efficient in the car shop in their younger days, but who are not as active now as they once were, make good instructors, and in this way they perform a service for the company while earning wages in a capacity for which they are well fitted. Such instructors may be stationed at different large repair points, where their services will accomplish much good for the company.

It is well known, too, that even an expert workman or instructor may not know everything, and therefore he should supplement his experience with knowledge pertinent to the different repair work regarding which he instructs his fellow men. Preferred ways of working may therefore be suggested to him by the master mechanic and car shop foremen. Years ago, a foreman was supposed to be everywhere all the time, with the result that oftentimes he was nowhere to be found, when lo! he would finally be spied creeping out from under some car where he had been showing a workman how to connect up airbrake pipes and valves—the workman having gotten the rigging apart in making repairs and not knowing how to get it back again so as to work properly.

The day is passing when the master mechanic can beckon to idle workmen from the office door, and consequently the men he does employ in the car shop he should make as proficient as possible by vocational instruction.

Heretofore, railroads have given little attention to taking a raw recruit and making a car man out of him. He was usually put on as a helper and probably remained a nonentity for the want of instruction. Of course, a few of the best helpers finally pulled themselves out of the mire, while others remained carrying out car material, wheeling bolts, lifting timbers, and working as general roustabouts. However, some of these men have good material in them and it simply remains for the master mechanic to give them a little instruction in work a step higher than what they are now doing.

A promotional system, promoting helpers to some line of car work, and dexterous workmen a step higher than their former work, is most urgently needed in many repair shops. Where such a system is in vogue the men feel they have something to work for, over and above the daily grind, and it helps to keep men who might otherwise become tired of their jobs by reason of seeing no chance to better themselves. Vocational instruction accomplishes this end.

Every town is filled with boys of working age, many of whom would make good car repairers, especially in cases where they expect to follow a trade rather than to learn a profession requiring an extensive education. During the summer, school boys or boys who have finished school, are glad to get something to do, and here the master mechanic has an opportunity to break in raw recruits who are used to learning and have sufficient comprehension to catch onto performing car work very readily under competent instruction. Even boys who work only during the summer and return to school in the fall, may be started in under some plan which enables them to complete their apprenticeship by working semi-annually.

The apprenticeship system in most shops requires bolstering, if indeed the railroads have any such system in the car shop. The taking on of apprentices is desirable on account of the scarcity of regular workmen. Every little while the newspapers herald, "Car Repairers Wanted," which shows that they are at least in demand in one place, and likewise the advertiser usually finds that workmen of this class are also scarce. Vocational instruction among apprentices and car men will help to overcome this condition.

In putting young men at work along side of their elders a strict system of discipline is necessary. Boys will play. They may be saucy or troublesome to old employes if not cautioned to pay attention to their work and act like men. Old workmen oftentimes feel that the younger men are being educated for the purpose of displacing them, but inasmuch as old employes are too serviceable to be dispensed with, the long-stayers should be given to understand that there is no thought of filling their places while they continue rendering the good services the company charishes.

With so much car work to do and so much of it being done, car instruction is necessary today, while in the past when traffic moved slowly and there was no general market for butter, eggs, potatoes, and almost everything that is eatable, car repairing was in its infancy. You have probably noticed that

in buying a product grown at home the price is about as high as though you were buying products grown a thousand miles away. That is because a general market prevails on many products, so that the price is usually about so high regardless of where the product is grown. All lines of manufacturing have doubled in the past few years, and with all these commodities on the rails an immense amount of shipping is done, requiring thousands of cars and a heavy repair expense which must necessarily be handled as efficiently as possible on account of low per diem rates and freight rates which are lower than in former years. A freight train may go in the ditch and consume the profits of a thousand shipments, with consequent heavy damage claims, and the only good feature about it is the work car men are given in putting the wrecked equipment in running order. Such repairs in connection with the multitude of regular running repairs require an army of efficient car repairers, and in order to do the work economically and under the best methods, vocational instruction should be given an inning in the car shop. It is a safeguard toward keeping cars in firstclass running condition.

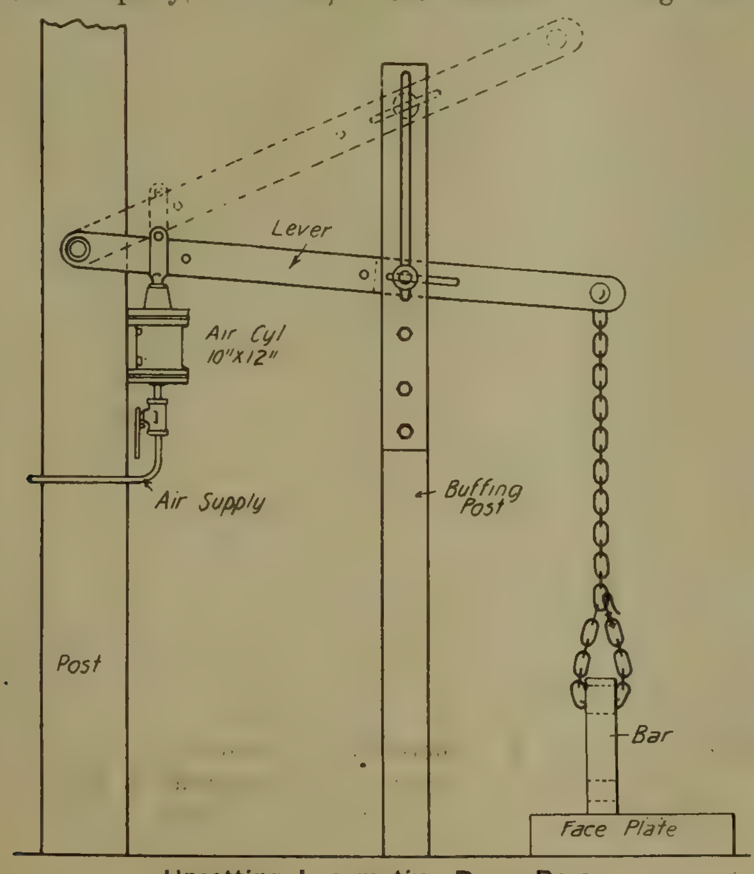
Almost any master mechanic can increase the efficiency of his car men by arranging to have them specially instructed in their daily work. The system adopted may not at first be extensive and may be improved upon from time to time, until finally it is sufficiently perfected to be worthy of the attention of higher officials, when an appropriation may be requested upon presentation of results which have already been accomplished and a complete outline of the training system which is recommended.

Meanwhile, car shop facilities should be improved upon, for good tools and machinery in the car shop come first in expediting the work of car repairs.

UPSETTING LOCOMOTIVE DRAWBARS.

By J. A. Jesson, L. & N. R. R., Corbin, Ky.

The illustration shows a device used in our blacksmith shop for upsetting locomotive drawbars, which is quite an improvement over handling them by hand, an operation requiring five men. With this device but two men are required, one to steady the bar, and one to operate the threeway cock. The bar is first raised from the floor to an upright position and the chain adjusted for the upsetting operation. The threeway cock receives air from the air supply through a one-quarter-inch choke to the brake cylinder and air is discharged from the cylinder through a standard one-inch cock hole, which allows the piston to return rapidly. The bar, in the meantime having been suspended some four feet, drops upon an upsetting block. The lever strikes against the buffer post before the piston has completed its return stroke. The iron parts of the post are made of ¼ x 4-inch strap iron clamped over each side of post. The lever is made of two pieces of ½ x 4-inch bar iron, 10 feet long, and is reinforced at the cylinder end with a piece of ¾ x 4-inch iron, 6 feet long. The arrangement may easily be understood by reference to the illustration.



Upsetting Locomotive Draw-Bars.

SAFETY IN PENNSYLVANIA SHOPS.

In September, 1910, the Pennsylvania Railroad employed the experts of one of the large accident liability insurance companies to make a thorough inspection of each shop plant. In consequence, it was deemed advisable to make the work of safety inspection a permanent feature and organize a safety movement to cover road and yard as well as shop conditions over the entire system. Safety committees were appointed in January, 1911, for each Superintendent's division, and for each shop for repairing engines and cars. These committees have made 17,333 formal recommendations, 13,861 having been complied with at a cost of $413,525.23. During the six months ended June 30, 1913, 3,209 safety recommendations were made, 2,390 being complied with at a cost of $75,361.97.

In addition to the divisional safety committees, a mechanical engineer was engaged for the specific purpose of making inspections at the various shops. During the year ended June 30, 1913, fifty-eight general inspections and fifteen special inspections were made. Usually the first inspection results in attention being called to all hazards and the following inspections are made to see that the recommendations for the installation of safety devices are complied with.

In order to make inspection even more effective, an additional inspector has been appointed to supervise road and yard conditions; both inspectors devote their entire time to safety work.

On May 1, 1913, as a means of educating employes, a pamphlet entitled "Safety Hints and Suggestions for the Prevention of Personal Injury Accidents" was issued. The instructions contained in this book are based on the combined recommendations of the safety committees, being supplemented by suggestions from the best experts in the country on mechanical and civil engineering and train operation. This pamphlet is practically a text-book on safety. As a guide to safety committees, it has proven most useful; over 120,000 copies have been distributed.

One of the results of all this detailed attention to safety is that $99,753 has been spent for safety guards—mainly in shops. Practically all machines and dangerous conditions are now guarded. But the real result is that serious accidents to shop employes have been reduced from 5.4 per 1,000 employes in 1911 to 3.2 in 1912. In 35 out of 46 shops, where more than 500 men are employed, the number of serious accidents per one thousand men has been reduced from 5 to 70 per cent. One of the results of the original attention to the subject, and the keeping of detailed statistics, is that when one shop does not show a satisfactory improvement, special inquiry is made with a view always to improving conditions.

New Books

STATISTICS OF FREIGHT TRAFFIC, by Julius H. Parmalee, Ph.D., statistician, Bureau of Railway Economics; published by LaSalle Extension University, Chicago.

One who reads this treatise may garner much valuable information concerning railway mileage, equipment and capitalization, as well as revenues, expenses and traffic. The treatise is one of a series of publications forming the basis of the LaSalle Extension University course of instruction by correspondence in Interstate Commerce and Railway Traffic. While statistics form, as a rule, dry reading, it cannot be said of this

work that it is dry. There is much of a story in the way it describes the development of railway operation.

THE INDUSTRIAL TRAFFIC DEPARTMENT, by W. N. Agnew, traffic manager, International Steam Pump Company; published by LaSalle Extension University, Chicago.

The duties of the Traffic Manager, as outlined by the author, are as follows: Quoting rates, routing of consignments, supervision of all shipping and receiving, taking complete responsibility for incoming and outgoing goods, and supervision of all work in connection with his office. The author explains how these duties may best be carried out. Some of the topics discussed in the work are Files and Furniture, Publications, Records, Tariffs, Rates, Classification, Routing, Claims, Tracers, Accounting and Demurrage. Adequate test questions are provided. This treatise is interesting and practical and fills a long-felt want.

FREIGHT RATES: OFFICIAL CLASSIFICATION TERRITORY AND EASTERN CANADA, by C. C. McCain, chairman, Trunk Line Ass'n, and W. A. Shelton, A.M., former instructor, LaSalle Extension University; with appendix of test questions, 295 pp.; published by LaSalle Extension University, Chicago.

Many people have an idea that freight rates in the United States are made entirely without a definite system. The authors have demonstrated in this treatise that not only is the rate structure in the eastern part of the United States definite, but also that it approaches very closely a scientific basis. This is a work that will prove helpful to those who wish a clear and straightforward exposition of the subject of rates in this territory. It is published by the LaSalle Extension University in conjunction with its course in Interstate Commerce and Railway Traffic.

BASES FOR FREIGHT CHARGES, by C. L. Lingo, traffic manager, Inland Steel Company; published by LaSalle Extension University, Chicago.

The value of a traffic man's services to a concern is measured not only by his technical knowledge and understanding of railway tariffs, but also by his comprehensive application of such rules and practice to the business in which he is engaged. He must know how to put these rules into effect legally, and how to make use of all the means that are available or can be devised for the betterment and development of traffic. It is this knowledge that must be garnered by him who would be successful in this field of transportation and when he can take advantage of Mr. Lingo's experience he is fortunate. Among the topics discussed are Freight Tariffs, Rates, Weights and Special Charges.

POCKET COMPANION FOR ENGINEERS, ARCHITECTS AND BUILDERS, by Carnegie Steel Co., 16th edition; leather, 5 x 8 inches, 400 pages, illustrated; published by Carnegie Steel Co., Pittsburgh, Pa.; price, $1.00.

An entirely new handbook, re-written from beginning to end, to take the place of the old Carnegie handbook so widely used by structural engineers. In its present form this book represents fully the present status and most approved methods in the art of steel construction. All shapes rolled are not illustrated on account of the greatly diversified line of products, therefore only such sections are illustrated as are suitable for bridge building, car and ship construction, and the tables given are limited to these constructions. The old rolling mill specifications have been replaced by those of the American Society for Testing Materials and those of the American Bridge Co. for workmanship. The new light weight beam sections are included, also new tables for plate girders, columns and struts; new data on floor construction; new treatment of stresses in beams, flexure formulæ and grillage foundations. Data and tables for reinforced concrete design have also been included and the data on roofs has been extended. In fact, the engineering data in the book has been practically doubled. The increase in size of the book is in the opinion of the reviewer an improvement allowing of better arrangement of tables. The makeup of the book is excellent and in all parts shows careful editing and selection of subject matter such as is necessary in creating a work of this sort.

AMERICAN RAILWAY MASTER MECHANICS ASSOCIATION. Proceedings of the forty-sixth annual convention. Cloth, 6½"x9", 856 pages with inserts, illustrated. Published by the secretary, J. W. Taylor, Karpen Building, Chicago.

This volume contains the entire proceedings of the convention held at Atlantic City, N. J., on June 11, 12 and 13, 1912, a full report of which was given in the July, 1913, issue of the *Railway Master Mechanic*. One of the valuable papers incorporated in the volume is the report of tests of a class E6s passenger locomotive made at the Altoona testing plant of the Pennsylvania. This covers 191 pages and is very complete.

MASTER CAR BUILDERS ASSOCIATION. Proceedings of the forty-seventh annual convention. Cloth, 6½"x9", 1,141 pages with inserts, illustrated. Published by the secretary, J. W. Taylor, Karpen Building, Chicago.

This year the proceedings of this association appear in two volumes, the first containing the minutes of the meetings held at Atlantic City, N. J., on June 16, 17 and 18, 1913, and the second containing the rules of interchange, results of letter ballots and the standards of the association. A detailed account of the 1913 convention was given in the July, 1913, issue of the *Railway Master Mechanic.*

AIR BRAKE ASSOCIATION. Proceedings of the twentieth annual convention. Leather, 6"x8½", 334 pages, illustrated. Published by the secretary, F. M. Nellis, 53 State street, Boston, Mass.

The convention, the proceedings of which are reported in this volume, was held at St. Louis, Mo., May 6, 7, 8 and 9, 1914. Among the papers presented are "Starting, Running and Stopping Long Freight Trains," "Will the Triple Valve Operate as Intended? That depends," "Air Hose Failures," "Steam Heat Traps and Their Relation to Wheel Sliding," "Undesired Quick Action—Prevention and Remedy." The book is well arranged and carefully edited. A valuable reference feature is an index containing the contents of all convention proceedings since the association was organized.

RAILROAD MASTER BLACKSMITHS ASSOCIATION. Proceedings of the twenty-first annual convention. Cloth, 6"x8½", 252 pages, illustrated. Published by the secretary, A. L. Woodworth, Lima, O.

The annual meeting of this association for 1913 was held at Richmond, Va., on August 19, 20, 21 and 22. Among the subjects discussed were "Flue Welding," "Superheater Flues," "Cast Steel in the Blacksmith Shop," "Electric Welding," "Tools and Formers," "Manufacturing Truck Transoms," "Spring Making and Repairing, "Oxy-acetylene Welding," "Properties of Iron." The above subjects indicate that the association chooses topics pertaining directly to the interest of the members and does not wander into other fields as is sometimes the case. The association now has a total membership of 277. Its proceedings indicate careful work on the part of the secretary.

POCKET DIARY AND YEAR BOOK. Cloth, 6"x4", 443 pages, illustrated. Published by Emmott & Co., Ltd., 65 King street, Manchester, England. Price 25 cents.

This book is prepared yearly by the publishers of the "Mechanical World." It contains sections on steam turbines, machine tools, grinding, etc., together with many tables and other data of interest to mechanical men. At the rear is a diary or memorandum pages for 1914.

ELECTRICAL POCKET BOOK. Cloth, 6"x4", 311 pages, illustrated. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price 25 cents.

Among the subjects covered in the book are: Telephones, lifting magnets, dry batteries, conductors and cables, accumulators, electric lighting, electric lamps, etc., together with considerable other data. A diary for the year is also included.

Personals

W. H. Davies succeeds E. J. Mayer as road foreman of the *Chicago & Alton*, with office at Bloomington, Ill.

C. D. Ashmore has been appointed assistant master mechanic of the *Chicago & North Western*, with office at South Pekin, Ill. Mr. Ashmore commenced railway work in November, 1889, as an engine crew caller for the Chicago & North Western at Boone, Ia. In 1890 he became a machinist apprentice and continued in this work until 1898, when he left and worked as a machinist and freight brakeman on various roads throughout the west. In

C. D. Ashmore.

1902 he returned to the Chicago & North Western and worked as a machinist and foreman at Council Bluffs, Ia., until 1908. From 1908 to 1909 he was roundhouse foreman on the Ashland division at Antigo, Wis., and from 1909 to 1910 was division foreman at Fond du Lac, Wis. In 1910 he returned to Antigo as division foreman and in 1911 was appointed general foreman at Clinton, Ia., holding this position until promoted as above mentioned.

George Shimming succeeds J. F. Cosgrove as shop foreman of the *Chicago & North Western* at Madison, Wis.

H. B. Forsberg succeeds William Hill as shop foreman of the *Chicago & North Western* at Superior, Neb.

W. S. Whitford, shop foreman of the *Chicago & North Western*, has been transferred from Fond du Lac, Wis., to Milwaukee, Wis., succeeding W. W. Hoffman.

T. J. Stocks, shop foreman of the *Chicago & North Western*, has been transferred from Janesville, Wis., to Fond du Lac, Wis., succeeding W. S. Whitford.

W. Wade succeeds T. J. Stocks as shop foreman of the *Chicago & North Western* at Janesville, Wis.

E. B. Hall has been appointed assistant to the general superintendent of motive power of the *Chicago & North Western* with office at Chicago, Ill. Mr. Hall was formerly master mechanic at Chicago.

George C. Bingham has been appointed general foreman of the *Chicago & North Western* at Huron, S. D. He succeeds F. W. Anderson.

J. G. Dole has been appointed master mechanic of the *Chicago, Burlington & Quincy* with office at Alliance, Neb., vice T. J. Raycroft, resigned. Mr. Dole entered the service of the Burlington at McCook in October, 1897, as machinist apprentice, and has held various positions on the lines West until May 15, 1912, when he was made general foreman at Lincoln. This position he held until his recent appointment. Mr. Dole's promotion comes as a recognition of his past services as a railroad man.

Charles Ray succeeds E. S. Barstow as car foreman of the *Chicago, Milwaukee & St. Paul* (Puget Sound Lines) with office at Tacoma, Wash.

A. J. Klumb succeeds C. Lundburg as assistant master mechanic of the *Chicago, Milwaukee & St. Paul*, with office at Milwaukee, Wis.

W. Snell has been appointed general foreman, car department of the *Chicago, Milwaukee & St. Paul* at Minneapolis. He succeeds to the duties of W. A. Parker, resigned.

R. S. Mennie has been appointed engineer, shop improvements, of the *Chicago, Rock Island & Pacific*, succeeding W. J. Eddy, promoted. His headquarters are at Chicago.

F. W. Wilson has been appointed supervisor of locomotive operation of the Cedar Rapids, Minnesota and Dakota divisions of the *Chicago, Rock Island & Pacific*, with headquarters at Cedar Rapids, Ia.

S. T. Patterson, supervisor of locomotive operation of the Chicago terminal and Illinois divisions of the *Chicago, Rock Island & Pacific*, has had his jurisdiction extended over the East Iowa. His office, as before, is at Chicago.

John Benzies, supervisor of locomotive operation of the Missouri and Des Moines Valley divisions of the *Chicago, Rock Island & Pacific*, has had his jurisdiction extended over the West Iowa division. His headquarters remain at Trenton, Mo., as before.

C. H. Rost has been promoted to general storekeeper of the *Chicago, Rock Island & Pacific*, succeeding Daniel Kavanaugh, with office at Silvis, Ill.

W. W. Griswold succeeds C. H. Rost as stationer of the *Chicago, Rock Island & Pacific*. His office is at Chicago, Ill.

J. J. Carey succeeds C. A. Gill as master mechanic of the *Cincinnati, Hamilton & Dayton*, with office at Ivorydale, O.

D. J. Mullen has been promoted to assistant superintendent of motive power of the *Cleveland, Cincinnati, Chicago & St. Louis*, with office at Indianapolis, Ind. Mr. Mullen was formerly master mechanic at Mattoon, Ill.

J. J. Karibo succeeds D. J. Mullen as master mechanic of the *Cleveland, Cincinnati, Chicago & St. Louis*, with office at Mattoon, Ill.

J. M. Davis, master mechanic of the *Colorado & Southern*, has been transferred from Trinidad, Colo., to Denver, Colo.

A. Roesch succeeds J. M. Davis as master mechanic of the *Colorado & Southern* at Trinidad, Colo. Mr. Roesch was formerly traveling engineer at Denver, Colo.

C. J. Shaughnessy succeeds A. Roesch as traveling engineer of the *Colorado & Southern* at Denver, Colo.

A. Hume succeeds C. J. Shaughnessy as traveling engineer of the *Colorado & Southern* at Trinidad, Colo.

P. J. Flynn has been appointed general foreman of the *Delaware, Lackawanna & Western* at Syracuse, N. Y., succeeding B. F. Roosa.

C. A. Henkel succeeds G. I. Murphy as traveling engineer of the *Denver & Rio Grande*. His office is at Grand Junction, Colo.

W. R. Elmore has been appointed general foreman of the *Denver & Rio Grande*, with office at Salt Lake City, Utah.

B. Ferris has been appointed acting general foreman of the *Detroit, Toledo & Ironton* at Delray, Mich., succeeding O. S. Throop.

George Gilmore has been appointed general foreman of the *Detroit, Toledo & Ironton* at Debray, Mich.

J. J. Dowling has been appointed superintendent of safety of the *Great Northern*, with office at St. Paul, Minn.

M. J. Flanagan, master mechanic of the *Great Northern*, has been transferred from Minot, N. D., to Everett, Wash.

John Delaney succeeds M. J. Flanagan as master mechanic of the *Great Northern* at Minot, N. D.

J. Q. Myers succeeds S. J. Taylor as locomotive foreman of the *Great Northern* at Grand Forks, N. D.

H. H. Gerbach succeeds C. J. Grant as car foreman of the *Great Northern* at Great Falls, Mont.

W. A. Hall has been appointed master mechanic of the *International & Great Northern* at Mart, Texas. He succeeds T. H. Williams.

Frank H. Adams has been appointed in charge of the mechanical department of the western district of the valuation board of the *Interstate Commerce Commission.* His headquarters are at Kansas City, Mo. Mr. Adams on February 1, 1914, resigned as engineer, shop extension, for the Santa Fe System, with headquarters at Topeka, Kan., to accept this position. He will have direct charge of the federal valuation of motive power, rolling stock and shop machinery and tools in the western district, which comprises the states of North and South Dakota, Nebraska, Kansas, Oklahoma, Texas, Colorado and Missouri. Mr. Adams was educated in the high school and at the University of Minnesota. His railway experience began in September, 1887, on the St. P. & D. R. R. at St. Paul, Minn., where he served a special apprenticeship until February 12, 1891, when he entered the service of the Gulf lines of the Santa Fe system at Galveston, Texas, as chief draftsman in the office of the superintendent of machinery. He continued in this position with various other duties until November 1, 1901, when he was promoted to the position at Topeka, from which he has just resigned.

O. E. Stemp succeeds F. McCutcheon as traveling engineer of the *Kansas City Southern* with headquarters at Shreveport, La.

T. Nicholson succeeds M. F. McCarra as master mechanic of the *Louisiana Railway & Navigation Co.*, with office at Shreveport, La.

William Apted succeeds W. R. Walsh as road foreman of engines of the *Michigan Central* at Detroit, Mich.

J. O. Clendenen has been appointed road foreman of engines of the *Norfolk & Western* with office at Portsmouth, O. He succeeds H. S. Walker.

R. L. Black has been promoted to general foreman of the *Norfolk & Western* at Columbus, O.

T. L. Brown has been promoted to general foreman of the *Norfolk & Western* at Kenova, W. Va.

N. W. Norsworthey has been promoted to general foreman of the *Norfolk & Western* at Crewe, Va.

D. C. Clough succeeds G. H. Hopkins as master mechanic of the *Oregon Electric*, with office at Portland, Ore.

F. E. Wolfe succeeds William Belyea as road foreman of the *Pere Marquette* at Grand Rapids, Mich.

William Belyea has been appointed general foreman of the *Pere Marquette* with office at Benton Harbor, Mich.

Chas. McDermott succeeds F. J. Hill as chief electrician of the *Pere Marquette.* His office is at Grand Rapids, Mich.

C. M. Huffman succeeds J. M. Gailey as master mechanic of the *San Pedro, Los Angeles & Salt Lake*, with office at Milford, Utah.

C. T. Tillman has been appointed purchasing agent of the *South Georgia*, with office at Quitman, Ga.

D. Hickey has been appointed master mechanic of the *Southern Pacific* at Sparks, Nev.

H. L. Moore succeeds A. E. Hale as road foreman of engines of the *Southern Pacific* at Tucson, Ariz.

W. E. Stoermer succeeds C. H. Holdredge as road foreman of engines of the *Southern Pacific* at Los Angeles, Cal.

C. H. Holdredge, road foreman of engines of the *Southern Pacific*, has been transferred to Tucson, Ariz.

A. C. Adams has resigned as superintendent of motive power of the *Spokane, Portland & Seattle.*

John Dickson has been appointed general master mechanic of the *Spokane, Portland & Seattle* in charge of the mechanical department and the office of superintendent of motive power has been discontinued. His headquarters are at Portland, Ore.

F. S. Anthony has resigned as mechanical superintendent of the *Texas & Pacific.*

A. P. Prendergast succeeds F. S. Anthony as superintendent of machinery of the *Texas & Pacific*, with office at Marshall, Texas.

G. P. Young, general foreman of the *Toledo & Ohio Central*, has been transferred from Columbus, O., to Bucyrus, O.

R. Dennis succeeds G. P. Young as general foreman of the *Toledo & Ohio Central* at Columbus, O.

C. G. Hartman has been appointed master mechanic of the *Wisconsin & Michigan*, with office at Peshtigo, Wis. He succeeds C. H. Stroud, resigned.

OBITUARY.

Ellsworth Merriss died at his home at Pleasant Mills, Ind., on November 11, 1913. Mr. Merriss was joint car inspector at Lexington, Ky., until last March, when he resigned and retired to his farm. Death was sudden and due to a stroke of apoplexy. He was fifty-one years of age.

F. B. Boutet, assistant joint car inspector at Cincinnati, died November 15, 1913, at the age of forty-two. His railway service covered a period of twenty-one years, commencing when he became a car inspector in 1893. For the past six years he has acted as assistant joint car inspector of all railroads entering Cincinnati. He was a member of the Chief Interchange Car Inspectors' and Car Foremen's Association, and of the Masonic fraternity. He was a nephew (not a brother, as stated in the January issue) of Henry Boutet, chief interchange inspector at Cincinnati, and his passing away was deeply regretted by his large circle of friends.

Among The Manufacturers

PLANER INSTALLATION, BURNSIDE SHOPS, I. C. R. R.

The Illinois Central has just finished the installation of a large planer at its Burnside shops at Chicago which will greatly expedite the handling of side frames and other large work at that point. The new planer is 84"x84"x34', has a reversible motor drive and was built by the Cincinnati Planer Co. of Cincinnati, O. It is located in the central bay of the machine shop and the illustration shows the machine ready to do its first work on two side frames, which it will be noted are placed side by side on the table. The old machine used for this work could take but one side frame at a time and did not have the quick return and other advantages of the new machine.

Unlike the old-fashioned method of hand movement for the heads, this machine has rapid power traverse to all heads in any direction. The movements are independent of each other, and can be operated whether the table is in motion or not.

The motor seen on top of the housings is used for driving the rapid power traverse and feed to the four heads, for elevating and lowering the crossrail and for operating the pump which lubricates the ways.

The motor pinion engages into a large gear on the horizontal rapid traverse shaft, from which the pinion that drives the feed clutch receives its power. Near the center of this horizontal shaft is a gear meshing into a pinion on the gear case of the elevating device, through which power is transmitted for raising and lowering the crossrail. A lever from this gear case passes to the left side of the machine, which controls the raising and lowering clutches in the gear case.

The power feed to the tool heads receives its power from the driving clutch, which has a bell crank and link motion to the bevel gear on the large horizontal shaft. This bevel gear meshes into a gear on the vertical shaft, thence through a set of spur gears to the trigger gears on the end of the rail and side heads.

The driving clutch is tripped from a rod which receives its motion from the tumbler and dogs on the side of the table and bed. The amount of feed is varied by the graduated slot heads, which indicate the exact amount of feed at all times.

The rapid power traverse receives its power from a second vertical shaft on the side of the housing, very much similar to the feed arrangement. Small handles on the end of rail and side heads operate the rapid power traverse and feed. Turning these handles to the left engages the rapid traverse and to the right the regular feed, and in no case can both be engaged at the same time. The handle at the lower end of rail is used for reversing the direction of the rapid traverse. All this is contained in the gear case at the end of the rail, and at no time is it necessary for the operator to step from his regular position for any of these changes. Resting on the crossrail at the right is a block containing two push buttons by means of which the operator may get movements of a quarter of an inch if necessary. The gears are thoroughly guarded against accidents to the operator.

All heads are taper-gibbed throughout, the clapper boxes are clamped by a heavy clamp and three screws instead of the usual two bolts through a cored slot.

The housings are of box form, tongued and doweled to the side of bed and further fastened at the top by an arch of box form closed on all sides and open only at the ends where it fastens against the housings. The cross rail is deep and is clamped to the housings with inside and outside clamps.

The table is of box form heavily ribbed throughout. The ways of the bed and table are oiled by forced lubrication from a pump at the back of the housing.

The bed is of the four-wall type and is bored to receive the driving shaft boxes, which are large in diameter and provided with special oiling arrangements with large chambers for oil. The driving gears are of steel and the pinions and table racks are of steel forgings.

The machine is driven by a 65 H. P. General Electric motor, the connections for which are very clearly shown in one of the illustrations.

MOTOR-DRIVEN MUD-RING AND FLUE-SHEET DRILL.

The accompanying illustration shows a Foote-Burt 4-spindle drill installed in the Juniata shops of the Pennsylvania R. R. where it is used for drilling the rivet holes around fire box mud-rings and the flue holes in boiler flue sheets.

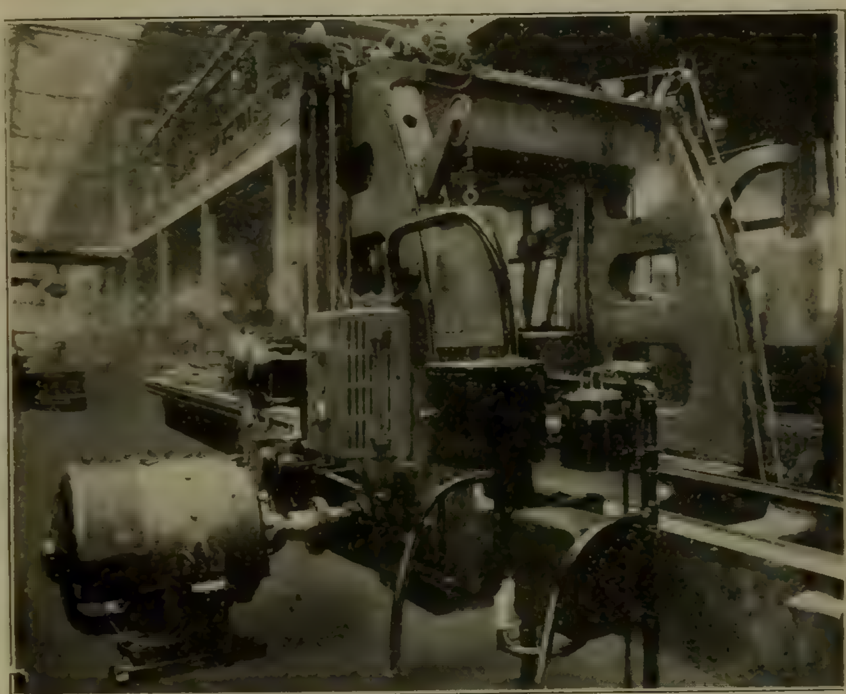
The heads of this machine have an adjustment in and out from the main cross-rail of 12 inches. They are also adjustable on the main rail up to a minimum center distance of 18 inches. Both of these adjustments are controlled by individual hand-wheels shown on the front of each slide.

The heads carrying the spindles are complete in themselves as each is arranged with a clutch for stopping and starting. Also each is fitted with geared power feed with adjustable stop for automatically knocking off same at any desired point. Two changes of power feed are provided on each head, either one of which is instantly available by simply shifting a lever conveniently located. In addition to power feed each spindle is furnished with hand feed through work gearing.

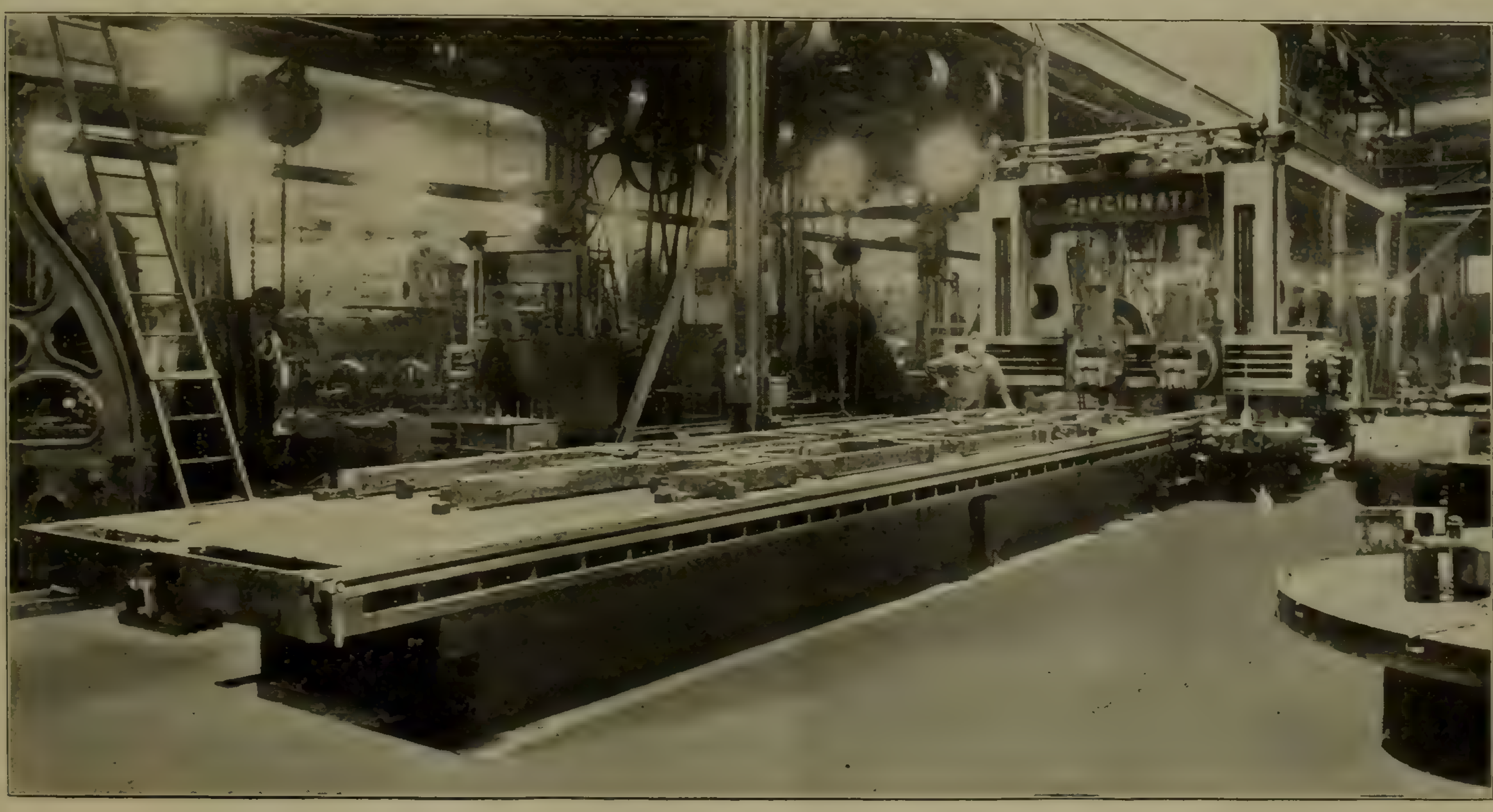
The rail of the machine is very heavy and of box form. The base is of continuous box section and the table is arranged with T slots and fitted with removable mud-ring chucks. The table has an in and out motion of 36 inches controlled by a lever at either end of the machine.

The motor is of Westinghouse make, 20 horsepower and with speed adjustment of from 375 to 1500 r. p. m. It is geared direct to the drive shaft by a large spur gear and a rawhide pinion, both of which are guarded.

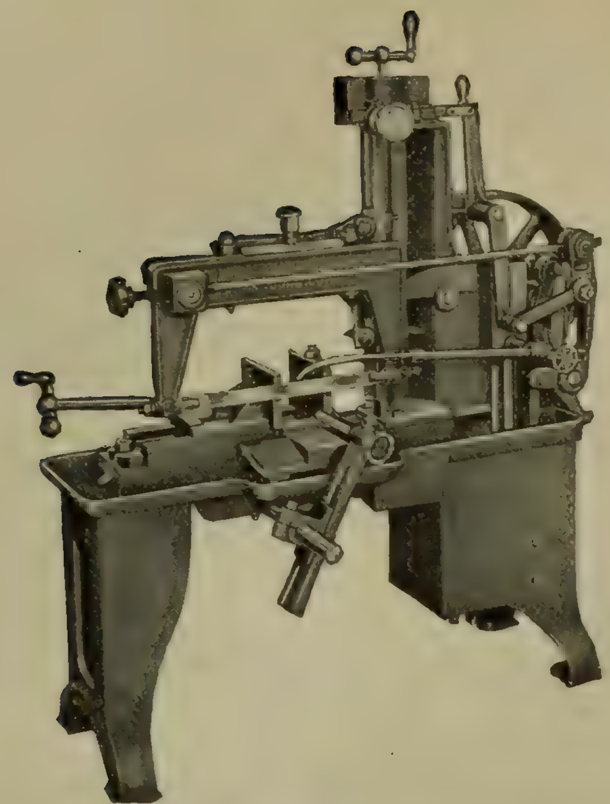
The weight of the machine is 23,000 pounds.



Housings, Motor and Electrical Connections of New Planer at Burnside Shops.



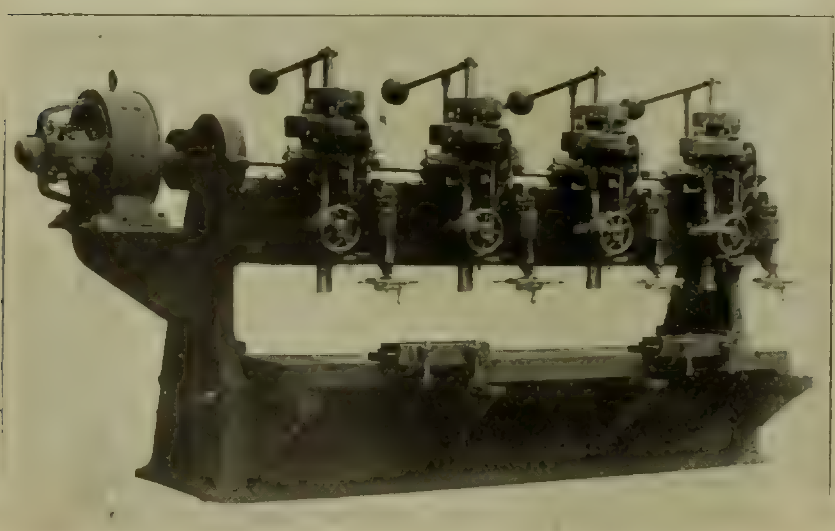
Large Planer Recently Installed at the Burnside Shops of the Illinois Central.



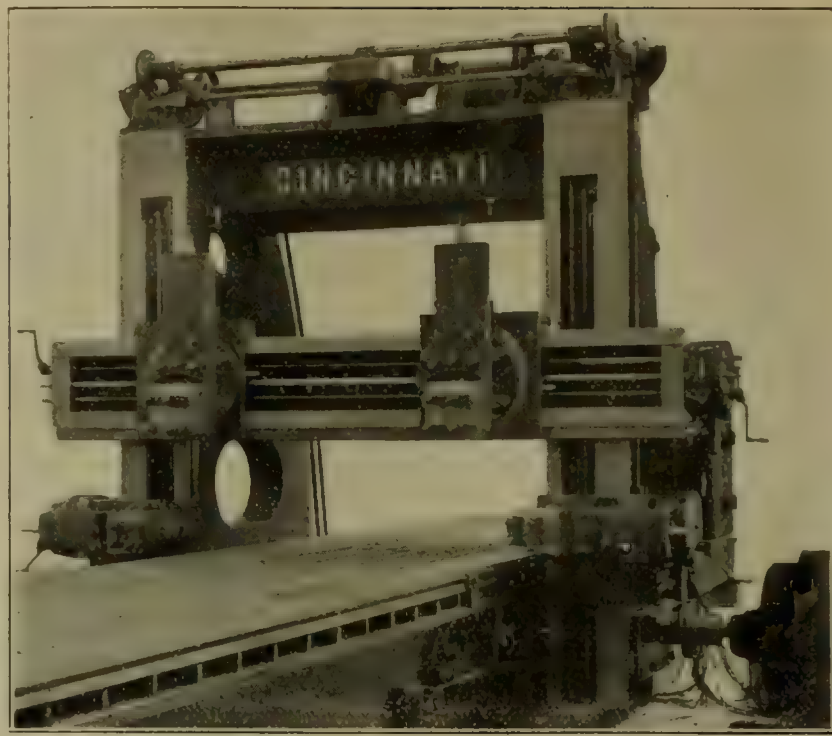
"Marvel" High Speed Hack Saw.

HIGH SPEED HACK SAW.

The "Marvel" high speed hack saw shown in the illustration is constructed more on the lines of a machine tool than the ordinary saw. The manufacturers have combined first class construction with extremely high speed and a number of valuable improvements. It is stated that in repeated tests, with extreme pressure on the saw blade, 6-inch round cold rolled steel could be cut in the remarkably fast time of 10 minutes, 5-inch in 8 minutes and smaller sizes in proportionately fast time. The vise is quick acting and will swivel to either right or left. An interesting feature is the fastener at both ends of the blade, so arranged that the blade can be tilted to either right or left at either end. Another very valuable feature is the adjustment of the cutting feed by means of which any desired pressure on the blade can be obtained to suit any material from thin metal down to heavy solids. This is done by simply turning the graduated hand wheel shown on side near top of machine to proper point. Provision is also made for using up any unused portion of the blade by turning hand wheel shown at end of connecting rod which shifts the saw frame forward or back as desired. The saw lifts free of the work on the return stroke and a good feature in this connection is the quick return on the idle or back stroke. The horizontal position always maintained by the saw blade is a most desirable feature, especially when desired to saw only part way through material. The machine can be set to stop at any desired depth in the cut. Adjustments, take-ups and oiling devices are provided throughout. It is manufactured by Armstrong-Blum Mfg. Co., 339 N. Francisco Ave., Chicago, Ill.



Individual Drive Multi-Spindle Drill.

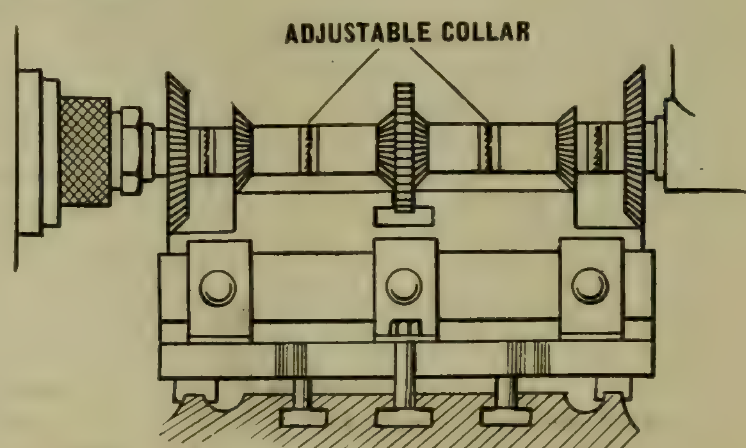


View of Burnside Planer While Assembled at the Plant of the Maker.

ADJUSTABLE SPACING COLLAR.

The illustrations show something new in the form of an adjustable spacing collar. It is designed primarily for use in milling machine manufacturing operations where two or more milling cutters on the same arbor must be spaced exact distances apart. As those familiar with straddle or gang milling machine operations know, it is sometimes necessary to grind the sides of the teeth of the milling cutters. This, of course, changes the distance between the faces of the milling cutters and in order to maintain sizes on the piece being manufactured, compensation must be made in some way for the amount ground off the cutter. This is sometimes accomplished by carrying in stock an assorted lot of solid spacing collars of varying lengths, and if the exact size cannot be found provision must be made by grinding off a solid collar, that is too long, or shimming up one that is too short, during which time the milling machine is standing idle.

"Wear-Ever" Spacing Collar.



Showing Collar in Position.

The "Wear-Ever" collar is so designed that thicknesses may be varied a total of .024 of an inch. This is divided into twelve spaces of .002 each. The adjustment of the collar is quickly made and after each adjustment it is absolutely the same as a solid collar. With the threaded collar sometimes used there are inaccuracies due to the wear of the threads. Scully, Jones & Co., Railway Exchange Building, Chicago, are putting this collar on the market.

RALCO PLUG AND RECEPTACLE.

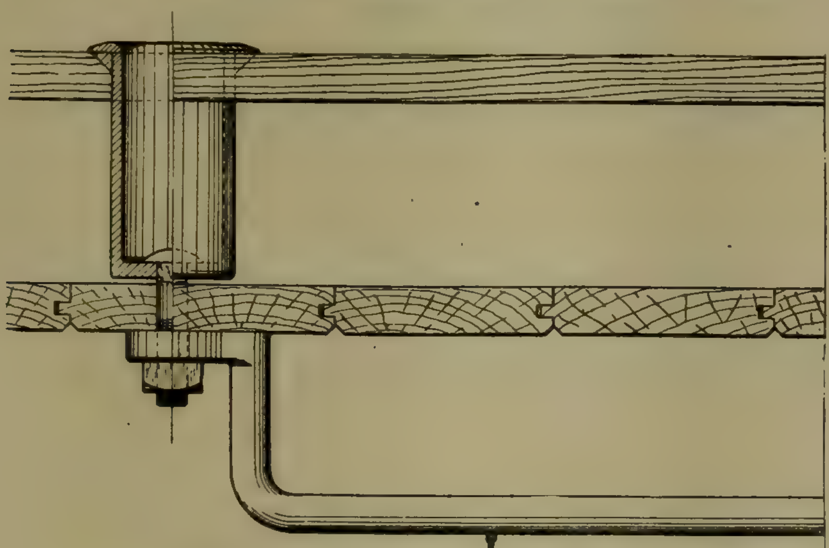
Since designing and placing on the market the first Ralco plug and receptacle, the Central Electric Co. of Chicago has seen the demand for this heavy duty plug increase step by step. Today there is a demand for the Ralco plug, and this demand may be partially attributed to the constant lowering in cost of current by

Ralco Plug.

municipalities and operating companies. This low cost of current makes economical the use of many electrical devices, whereas before the high cost of current practically prohibited their use. The illustration shows a 30-ampere Ralco plug and receptacle. The Ralco line of heavy duty plugs and receptacles are being used today in shops for portable grinders, riveters, boring tools, forges and lathes. The rigidness of these receptacles and plugs means safety and low maintenance cost.

WINE SOCKET WASHER FOR GRAB IRONS.

The drawing herewith shows a washer which has been developed for use in applying safety appliances to box cars. In applying ladders or grab irons to cars, it is necessary that there be a block or cripple between the siding and lining in order to allow the bolt to be drawn up tight and make the ladder or grab iron



Wine Socket Washer for Grab Irons.

secure. In the majority of cases where ladders or grab irons are applied to existing cars, it is necessary to remove either the siding or the lining, apply a cripple block, and then apply new siding or lining in place of that removed.

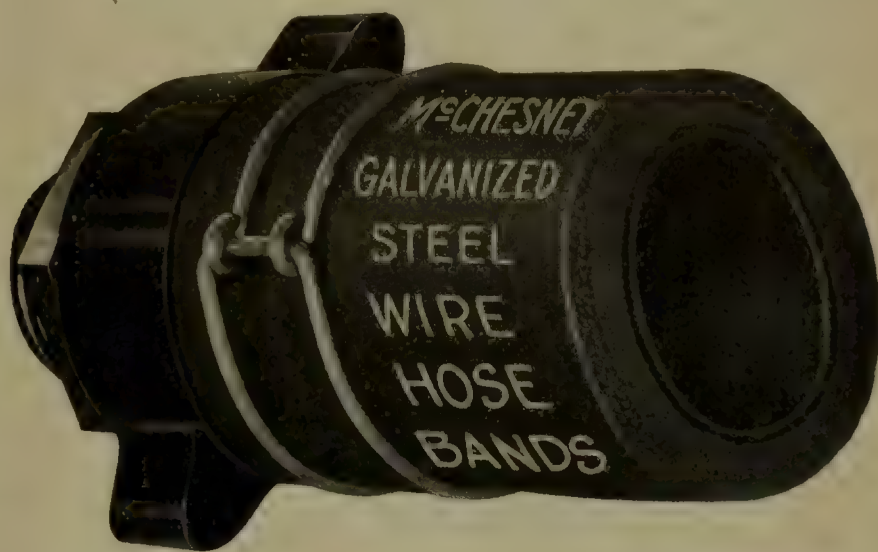
In order to facilitate and cheapen the application of these appliances the Wine socket washer, which is very easily applied and makes the grab iron or ladder much more firm and secure than by the use of a cripple block, has been designed.

By making the washer about ⅛ inch short, and as there is only ¾ inch thickness of wood to shrink and wear, the device when properly applied should remain firm and tight indefinitely. This washer can be designed in such a manner that the bolt may be removed and replaced from the outside of the car.

The economy and practicability of the device will be readily recognized by practical car men, and the Wine Railway Appliance Co., Toledo, Ohio, the manufacturer, has filled orders of a number of the leading railways of the United States and Canada, for over 100,000 of these washers within the past year.

GALVANIZED STEEL WIRE HOSE BANDS.

A wire hose band designed to take the place of the hose clamps now in general use is being offered by J. S. McChesney & Co., 139 N. Clark street, Chicago. A decided advantage in the construction of this band is that it has no protruding joint to catch as the hose is dragged about. One length of band will cover all sizes and plies of hose from 1-inch to 2-inch, while the larger sizes will cover a corresponding range in hose dimensions. Stocks can



be replenished quickly by small shipments via parcels post, doing away with the necessity of carrying a greatly assorted stock of sizes which may never be called for as is the case with hose clamps. They are less expensive, stronger and more quickly and easily applied than any hose clamp. They can be applied without disturbing the hose connection if conditions make this desirable, which makes them ideal for emergency repair work.

The bands are electrically welded and made in six sizes for hose ranging from ¾ to 4-inch, and are applied with a tool provided with means of adjusting itself so that one band may be used on two or more sizes of hose.

NON-STRAIN EYE PROTECTORS.

Statistics show that over sixty per cent of the total personal injury cases among industrial workers are injuries to eyes, caused for the most part by flying particles and heat glare. Yet it is only within a comparatively recent period that this very important

Non-Strain Eye Goggles.

subject of eye injury has been given the attention it deserves.

One of the best known types of protectors which has gained popularity among railroad employers is the No. 284 special engineers' and firemen's goggle as illustrated herewith. This goggle was designed and patented some ten years ago by the Ophthalmuscope Company of Toledo, O., and embodies many original features which have made it indispensable, not alone

to engineers and firemen of railroads, but to the man in the shop as well.

The frame is of aluminum, making it very light and strong, and is so constructed that the lenses can be changed immediately to any color or thickness of glass desired. If the work requires something different from glass, mica, celluloid or similar lenses can be substituted. These lenses can be changed in less than a minute of time by merely unscrewing the large aluminum outside ring which holds the lens in place, the operation requiring no tools of any kind nor the use of small screws which would be easily misplaced and lost. This construction admits of perfect ventilation and is thoroughly dust-proof, the ventilation holes being back of the lens on an angle, thus preventing the dust from driving in. The lenses are 2⅜ inches in diameter, are perfectly round, and can be replaced at an expense of only 12c per pair.

The manufacturers of non-strain goggles have protected themselves against infringement by adopting the trade mark "Non-Strain," which appears on all goggles made by them, and which is a guarantee against inferior design and quality.

New Literature

W. L. Brubaker & Bro., Millersburg, Pa., have recently issued catalogue No. 3 which illustrates and describes the full line of taps, dies, reamers and screw plates manufactured by this firm. They have been in business since 1880 and in the thirty-three years since have developed a large railroad business by confining their products to the above mentioned line and by guaranteeing accuracy, uniformity and long life. The catalogue contains complete information with regard to their products, together with prices.

* * *

The National Tube Co., Pittsburgh, Pa., has issued a neat "Safety First" calendar for 1914. The illustration is in colors and over the caption "Taking no chances," shows a party of automobilists taking the proper precautions at a grade crossing. Each month bears a separate motto on safety.

* * *

The December issue of "Staybolts," issued by the Flannery Bolt Co., Pittsburgh, Pa., contains an article on the breakage of staybolts due to burnt ends.

* * *

The Chicago portable mine hoist is described in a booklet recently issued by the Chicago Pneumatic Tool Co. of Chicago.

* * *

"Gears and rolling mill pinions" is the subject of Bulletin K of the Mesta Machine Co., Pittsburgh, Pa. These gears are all machine molded.

* * *

"How much excess fuel does your boiler require" is the question asked by the Federal Graphite Mills, Cleveland, O., in a recent booklet. It sets forth why Federal graphite is a practical and economical scale remedy.

* * *

"Story of the Imperial" is the title of a 9x12 booklet just issued by the Ingersoll-Rand Company, 11 Broadway, New York City. Novel and exceedingly attractive in design, it features, in brief and simplified form, the superior points of design and construction maintained in the Imperial line of air compressors. Page for page it carries the reader through the various stages of construction, giving a very concise and elaborate idea as to just how the machines are built.

* * *

The W. S. Rockwell Company, New York, has published a catalogue on Rockwell furnace service. A large variety of furnaces are listed and illustrated. This firm makes plant inspections, devises methods and means of working, prepares plans and furnishes complete furnace equipment for shops.

* * *

Bulletin 600 B, descriptive of Hyatt roller bearings, has been issued by the Hyatt Roller Bearing Company, Chicago, Ill. The distinctive feature of these bearings is the roller, which is made from a strip of steel wound into a helix of uniform diameter and gives greater flexibility to the rollers. This in turn secures a uniform distribution of the load.

* * *

The Cincinnati Milling Machine Company, Cincinnati, O., has published a new circular on duplex, plain and face semi-automatic millers. They are called semi-automatic millers because they are so constructed that by means of trip dogs the machines can be set so as to make them entirely automatic, the work of the operator being confined to chucking the pieces. The design provides for an intermittent feeding arrangement, whereby the machine has quick traverse to bring the work to cutter, then drops down to the selected feed rate across the piece, then quick traverse again to the next piece, and so on, jumping the gap between any number of pieces that may be strung along on the table, and after the last piece has been traversed, the machine may either stop or trip so as to automatically reverse, and quick traverse to the starting point. These machines are especially adapted for milling such work as is manufactured in large quantities.

* * *

The National Malleable Castings Company has issued a booklet giving the advantages of steel castings produced in electric furnaces, together with illustrations of same.

* * *

The National Tube Co. of Pittsburgh has issued a booklet on the subject of "National" reamed and drifted pipe containing a complete description of this product together with a short introduction explaining the process of well drilling and information relative to the various accessories necessary for the drilling and pumping of wells.

* * *

The National Machinery Co., Tiffin, O., has published "Forging Machine Talk No. 1," which is the first of a series of leaflets on this subject. This first leaflet sets forth what the forging shop demands today.

* * *

Watson-Stillman Co. of New York has just issued catalogue No. 89, its title being "Heating, Chilling and Die Presses." It contains 56 pages and shows a complete line of presses. The construction of these three types is similar and often but a few alterations are needed to change a press from one class to another.

ON THE JOB.

"Where's the president of this railroad?" asked the man who called at the general offices.

"He's down in Washington, attendin' th' session o' some kind uv an investigatin' committee," replied the office boy.

"Where is the general manager?"

"He's appearin' before th' Interstate Commerce Commission."

"Well, where's the general superintendent?"

"He's at th' meetin' of th' legislature, fightin' some bum new law."

"Where is the head of the legal department?"

"He's in court tryin' a suit."

"Then where is the general passenger agent?"

"He's explainin' t' th' commercial travelers why we can't reduce th' fare."

"Where is the general freight agent?"

"He's gone out in th' country t' attend a meetin' o' th' grange an' tell th' farmers why we ain't got no freight cars."

"Who's running the blame railroad, anyway?"

"Th' newspapers and th' legislatures."—*Pittsburgh Press.*

The Selling Side

THE CHICAGO CAR HEATING COMPANY has recently opened a branch office and factory at 61 Dalhousie street, Montreal Canada, to take care of its rapidly increasing business in the Dominion. A. D. Bruce, formerly purchasing agent of the company at Chicago, is in charge. Mr. Bruce is a native of Guelph, Ontario, but has been connected with the Chicago Car Heating Company in Chicago for the past five years. Karl A. Heine has joined the sales department of this firm, with offices in Grand Central Terminal building, New York City.

EDWIN EMERSON NOLAN, head of the materials disposition department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., died at his home in Wilkinsburg, Pa., on Tuesday, January 13.

PETER M. KLING has been appointed assistant to the president of the Laconia Car Company, with headquarters at Laconia, N. H.

At the annual meeting of the ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS, recently held in New York, the following officers were chosen: President, T. A. Griffin, Griffin Car Wheel Company, Chicago; vice-presidents, E. F. Carry, vice-president and general manager, American Car & Foundry Company, Chicago; J. A. Kilpatrick, president, Albany Car Wheel Company, Albany, N. Y.; secretary and treasurer, George W. Lyndon, Chicago.

A. E. Schafer.

A. E. SCHAFER, who has been general sales manager of the Sherwin-Williams Company, has accepted a position with the Flint Varnish Works, Flint, Mich. He will assist President W. W. Mountain in the management, and will have full charge of the railroad department. Mr. Schafer was with the Sherwin-Williams Company for 28 years, the last 6 years as general sales manager.

S. F. BOWSER & Co. of Fort Wayne, Ind., are building an addition to the boiler shop which will almost double its capacity.

The offices of CHARLES R. LONG, JR., & Co., and the headquarters of Harry Vissering & Co., Inc., at Chicago, have been removed from the Great Northern building to the sixteenth floor of the Lytton building.

THE DES MOINES BRIDGE & IRON COMPANY, of Pittsburgh, Pa., and Des Moines, Iowa, have opened a contracting office at 50 Church street, New York.

The general Chicago offices of the Erie have been moved from the Railway Exchange to the Transportation Building, Dearborn and Harrison streets.

FRANK D. WALLER, formerly secretary of the Flower Waste & Packing Company, New York, has become the owner of that company.

THE METAL CAR SEAL COMPANY of Chicago has changed its name to the Edgar Steel Seal and Manufacturing Company.

THE UNITED STATES LIGHT & HEATING Co. has changed the location of its New York City branch sales office from 30 Church street to 210 West 50th street, bringing the New York service station and sales office into the same building. The general offices of the company remain at 30 Church street.

WILLIAM THORNTON HENRY, sales manager of the New York Air Brake Co., died recently.

THE RAILWAY BUSINESS ASSOCIATION will have the following officers for the coming year: President, Geo. A. Post, New York; treasurer, Chas. A. Moore, New York; assistant treasurer, M. S. Clayton, New York; vice-presidents, A. M. Kittridge, Dayton, O.; W. E. Clow, Chicago; G. W. Simmonds, St. Louis; S. P. Bush, Columbus, O.; Alba B. Johnson, Philadelphia; H. G. Prout, Pittsburgh; W. G. Pearce, New York.

GRAHAM GEDGE, formerly chief clerk and accountant of the Wichita Terminal Association, Wichita, Kan., has been appointed assistant sales manager of the Edgar Steel Seal & Manufacturing Co., Chicago.

CHARLES H. SCHLACKS has been elected president of the Hale & Kilburn Co.

THE CENTRAL RAILWAY SUPPLY Co., of Chicago, has moved to 176 North Market street.

JEROME-EDWARDS METALLIC PACKING Co. has placed its railway sales in the hands of the Equipment Improvement Co., 30 Church street, New York.

Arrangements have been made by T. H. GARLAND, inventor of the Garland ventilators, with the Ross-Wortham Co., 1818 McCormick building, Chicago, to handle his car ventilators and other devices invented by him. He will be identified with this firm in the improvement of ventilators and other specialties for passenger and freight equipment.

The officers and salesmen of BERRY BROTHERS, Detroit, Mich., held their annual meeting at Detroit last week.

THE DES MOINES BRIDGE & IRON Co., of Pittsburgh, Pa., and Des Moines, Iowa, opened a contracting office at 50 Church street, New York City, January 1, 1914.

THE LINK SIDE-BEARING Co., Hammond, Ind., has been incorporated to manufacture railroad trucks. The capital stock is $100,000.

The tenth annual convention of the sales and factory organizations of the CHICAGO PNEUMATIC TOOL COMPANY was held at the Great Northern Hotel, Chicago, last week. About one hundred of the company's representatives were in attendance from all parts of the world.

THE PULLMAN COMPANY has established a pension plan providing for the retirement of employees at the age of 70 or after 20 years of service in case of disability with a pension equal to one per cent for each year of service of the average rate of pay for the last year of service. No one over 45 years of age will be taken into service hereafter except by special arrangement.

ELMER E. ALBEE has resigned as mechanical superintendent of the Safety Car Heating & Lighting Company, New York.

B. S. MCCLELLEN, in charge of the railway sales department of the McCord Manufacturing Company, Chicago, has resigned in order to give more personal attention to his other interests. The McClellen Nut Company, Chicago, which he has just organized, will shortly place upon the market a one-piece self-locking nut, which will be known as the "Unit" lock nut.

D. WALKER WEAR, formerly purchaser of the Chicago Tunnel Co., has been elected vice president and a director of the Stow Mfg. Co., with offices at 443 State street, Binghamton, N. Y.

R. M. CAMPBELL has been appointed special representative of the railway department in the eastern territory of the Detroit Graphite Company, Detroit, Mich., with headquarters at 135 Broadway, New York City. Mr. Campbell was for a number of years with the Ohio Brass Company and the Transportation Utilities Company.

THE DUFF MANUFACTURING Co., of Pittsburgh, Pa., has opened an office in the People's Gas Building, Chicago. Backed by a Chicago warehouse, they will be in a position to give Western consumers increased service and prompt deliveries. The company has also appointed G. W. Parsons, district sales agent with offices in the Pioneer Building, St. Paul, Minn. By mutual agreement, Fairbanks, Morse & Co. have discontinued acting as exclusive steam railway agents for the above company.

THE HANCOCK-BRAGG RAILWAY SUPPLY Co., Chicago, has been incorporated by William Bragg, David D. Kagy and R. W. Vanier.

ERICH JOSEPH, formerly New York manager of the Orenstein-Arthur Koppel Company, Koppel, Pa., has been appointed general manager of that company. He succeeds A. Reiche, who has left the company to engage in work in Germany.

THE SIMPLEX AIRBRAKE & MANUFACTURING Co. held its first annual meeting in its offices in Pittsburgh, Pa., on January 20. The following officers were elected: President, Milton D. Hays; vice-president, Nicholas Herbick; secretary, Elmer E. E. Stewart; treasurer, William H. Giob; assistant to president; A. P. Hays; mechanical engineer, Peter Wertz.

JOHN F. CHURCH has been appointed vice-president of the Damascus Brake Beam Company, Cleveland, Ohio.

J. H. WATTERS, master mechanic of the Georgia Railroad, has resigned and will devote his time to the introduction of his several patented locomotive appliances.

Charles E. Lee,

Who has been prominently mentioned to fill the vacancy in the presidency of the Boston & Maine. Mr. Lee was formerly connected with the Boston & Maine, and as general superintendent had the good will of 20,000 employees. His intimate knowledge of the physical property places him in an enviable position.

OBITUARY.

WILLIAM A. COOPER, director of building and equipment of the East Pittsburgh works of the Westinghouse Electric & Mfg. Co., died from peritonitis at his home in Wilkinsburg, Pa., Friday, January 23d. Mr. Cooper was born near Watertown, N. Y., November 24th, 1861. He attended Cornell University and began his business career with a cheese manufacturing concern at which time he had charge of a power plant, and in working therein his engineering instinct was aroused, which led him to adopt this as his life work. At the age of 25 Mr. Cooper went to Ottumwa, Ia., to engage in the building of automatic screw machines. Soon after he started a shop in Minneapolis for himself, undertaking at this time the development of a system of traction using compressed air. Following this period, Mr. Cooper entered the employ of the Twin City Rapid Transit Company of Minneapolis, as master mechanic and chief engineer. During the four years he spent in this position he redesigned and practically rebuilt the entire electrical equipment.

In 1894 he entered the employ of the General Electric Company at Schenectady, being engaged in railway work. During the period of three years at Schenectady he was a leading spirit in a great deal of the chief engineering work which resulted in the revolution of the design of railway motors. During his stay at Schenectady, he also supervised the manufacture of the locomotives for the Baltimore & Ohio tunnel at Baltimore, being detailed to put them into service after their erection. After the completion of this work Mr. Cooper became associated with the firm of Blood & Hale, consulting engineers,

William Cooper.

Boston, and on September 1, 1897, entered the employ of the Bullock Electric & Mfg. Company, Cincinnati, Ohio, as general superintendent in charge of engineering and manufacturing. After his experience as consulting engineer in Cincinnati for about one year, he entered, in 1904, the employ of the Westinghouse Electric & Mfg. Company in the railway engineering department. His first work with this company was his investigations of the unit switch control which the company was then exploiting. His work on this system led to the development of the type of control now being used by the Westinghouse company. His work in the railway field consisted of an active participation of the design and manufacture of the equipment furnished the New York, New Haven & Hartford, the St. Clair Tunnel, the Pennsylvania and other roads which have been electrified by the Westinghouse company. Two years ago, when the works department was organized, Mr. Cooper was made director of buildings and equipment. In this capacity he did some excellent work in remodelling the power plant at East Pittsburgh, leaving it in excellent condition.

Mr. Cooper was a man of rather rough exterior and apt to be misunderstood by people who did not know him thoroughly. His warm heart, however, and generous disposition made him universally loved and respected by those who were fortunate enough to know him intimately.

Foundations have been completed for the erection of the Baldwin Locomotive Works' plant at Calumet, near Gary, Ind. The shops will cover sixteen acres and will employ 10,000 men.

RAILWAY MASTER MECHANIC

**The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878**

Published by THE RAILWAY LIST COMPANY

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J. M. CROWE, Mgr. Central Dist. KENNETH L. VAN AUKEN, Editor
DALTON RISLEY, West. Mgr.

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, March, 1914 No. 3

CONTENTS.

Center Plate Oiler.

On another page we publish a short article descriptive of a center plate oiler used on the Denver & Rio Grande, which was designed by Master Mechanic Stevens of that road. Although a simple affair, it is a striking example of overcoming some of the small leaks in railway operation. Mr. Stevens says that they were able to oil but thirty cars per gallon of oil with the ordinary oiler and that they are able to cover sixty cars on the same amount of oil with the improved oiler. In addition there is a saving effected in the time consumed, and the danger to the man handling the oiler is decreased. Another interesting feature is that the oiling of center plates has resulted in a decrease in the number of truck derailments.

We need more devices of this sort in our shops and roundhouses; devices and improvements that will help to cut off the small leaks. At this time, more than ever before, efforts should be made to cut down costs. It is to be hoped that railway mechanical men who have succeeded in cutting costs by means of an improved tool or method will take every opportunity to acquaint their fellow railway men with it. Indeed, it should be a duty, for what will improve the welfare of the roads as a whole will improve the welfare of each separate road.

Tool Room Work.

With the incoming of machinery, each man working in a shop is being relieved of more and more manual work and is becoming to an increasing degree, a director of certain forces placed at his command. The power, the machine and the cutting tool is furnished and it is up to the operator to make them work as efficiently as possible. After furnishing good machines to the operator, the most important thing is to give him good cutting tools which will meet the requirements of the work, and to keep these tools in the best of repair for him.

This is the function of the tool room; to study out the best designs for the tools needed, to manufacture all the tools it can with economy and to keep the men supplied at all times with good tools. The tool room should always keep a step in advance of the shop and not simply keep abreast with it or lag behind it as is sometimes the case. On the whole, tool room foremen are up-to-date and alive to the possibilities of their work. This was well evinced at the last convention of the Tool Foremen's Association. Although this association has as yet a relatively small membership, no convention excelled it last year in enthusiasm and in thoroughness in discussing live subjects. Better designs of cutters, better means of tempering, and cheaper methods of manufacture are constantly being introduced and the man who is going to make the value of the tool room felt in his shop must be constantly studying the problems of the shop, devising methods of expediting the work and cutting costs wherever possible.

We present in this issue an article by Owen D. Kinsey, tool room foreman at the Burnside, Chicago, shops of the Illinois Central, covering the work being done in the tool room at that point. The tool room department at Burnside was reorganized last last fall and has been brought to a high state of efficiency since that time. At present it is manufacturing practically all the tools for the shop, aside from drills and taps. With each tool the prices of the manufactured product have been obtained and compared with the cost of manufacturing the same tool in

the tool room, with the result that a large percentage of the tools are being manufactured at home at a decrease in price of from one-third to two-thirds. Aside from the decrease in cost, the tool room is able to make tools which are especially adapted to the work of its shop. The article in question shows a few of the interesting jigs used for turning out the work. The tool room is located in a separate building adjoining the shop, has plenty of room between machines, good light and is kept in an orderly condition, all of which have a very good influence on the men who work in it. In spite of the fact that the tool room is supplying the shop with more and better tools at a lower cost, it is working with a smaller force than it did under the old regime. The force consists of twenty-four men, one-third of which are skilled mechanics, while the rest are bright young fellows who have been picked out of the shop.

It has been said that if you want a thing well done, do it yourself. One of the secrets of the success of the Burnside tool department is that Mr. Kinsey, the foreman, not only designed his own jigs but prepared all his own drawings. Although it used up many of his spare evenings he has a set of drawings which he knows to conform exactly to his desires and the requirements of the shop. It is such attention to details which makes for the success of any work. He is also encouraging the men to take courses in mechanical drawing and other studies which will help them in their daily tasks, and enable them to work understandingly. The Burnside tool room is turning out work which is a great credit to the Illinois Central Railroad and the shop management. The article referred to contains some valuable ideas with regard to tool room work and if there are other shop officials who believe they have better methods, they are invited to let our readers know about them. No one would be more anxious to learn of them than the tool room foreman at Burnside, for Mr. Kinsey is always in the market for new ideas. That is why the tool room at Burnside has cut down costs hundreds of dollars each month.

Pyrometer for Superheaters

In the operation of superheater locomotives it is unquestionably a fact that the best results consistent with good practice are not by any means always obtained. In the committee report and discussions of the American Railway Master Mechanics' and of the Traveling Engineers' Associations, there is much doubt expressed as to when superheaters are operated to best advantage. It has been shown that enginemen often carry water at too high a level in the boiler for the principal reason that it is possible to do so without the usual evidences of priming, which follows such practice with saturated steam locomotives, and further there is a tendency to provide as large a factor of safety as possible in avoiding danger of burning crown sheets. It has also developed that improper attention given the cleaning of the superheater flues has often resulted in a low standard of efficiency.

Since the evidence of such poor conditions is not at once brought to the attention of the enginemen or terminal forces for correction, the poor results are apt to continue to the detriment of the service. It is for these reasons that a pyrometer adapted to locomotive practice, has been developed by the Locomotive Superheater Co. This device is described on another page of this issue and it should attract favorable attention from those who have realized that they were not obtaining maximum efficiency. An indication of what is transpiring, so far as the functioning of the superheater units are concerned, is constantly before the eyes of the enginemen in the registration on the pyrometer dial and in most cases an indication of low temperature in the steam delivered to the cylinders will result in prompt corrective measures. There is slight increase of complication by its attachment to the engine and its simplicity is such as to insure its proper action.

Brake Performance Tests

With its characteristic thoroughness, the Pennsylvania Railroad working with the Westinghouse Air Brake Co., conducted during the past year a set of tests on brakes and brake performances which are of great value to the railway fraternity. In a paper by S. W. Dudley, delivered before the American Society of Mechanical Engineers on February 10, the writer does not go deeply into details but his discussion of the tests covers about a hundred and thirty pages, so it may be seen how thorough and comprehensive these tests were. Elsewhere in this issue we publish the introduction and conclusions of this paper; lack of space prevents us from giving more. As indicated in the article, those interested can readily obtain complete copies of the test.

The tests at the outset were to cover five points, namely: A determination of the maximum percentage of emergency braking power with a consideration of the various factors affecting it; a comparison of two brakes per wheel with the standard of one brake per wheel; a comparison of the improved electro-pneumatic brake with the present high speed brake equipment; observance of effects of braking on the brake shoes; the coefficient of friction between the wheel and the rail under varying conditions.

The improved electro-pneumatic equipment was found to be quick acting and very effective. For instance, the time to obtain full emergency braking power with the PM equipment on the entire train was 8 seconds while with the electro-pneumatic brake the time was 2:25 seconds.

With regard to brake rigging the paper says: "An efficient design of brake rigging must be produced before the advantages of improved air brakes or brake shoes can be fully utilized." The clasp type of brake rigging (two brakes per wheel) was found to be very advantageous both from the standpoint of the brake rigging and the brake shoe. The rail adhesion was found to vary from 15% to 30%, depending on the conditions of the atmosphere and weather, and the amount of wheel sliding it was concluded depended more on the rails and weather conditions than on the amount of braking power.

The brake shoe bearing was found to be the most difficult factor to control and the tests indicated that, with all factors except this remaining constant, there was a possible variation of from 15 to 20 per cent in the length of stops made from a speed of 60 miles per hour.

With our heavier rolling stock, longer trains and higher train speed the braking question is indeed an important one and much good should result from these tests. They are the most complete tests which have been made since the Galton-Westinghouse trials of 1878, which constituted the first scientific investigation of the subject, although the Lake Shore tests of 1909 contributed valuable data. They are a valuable contribution on the question and a study of them will be of great value.

Twenty Years Ago This Month

Henry L. Leach introduces an improvement on locomotive track sanding apparatus to cover emergency sanding, the improved device retaining the old sand lever in addition to the pneumatic appliances.

The general superintendent of one of the larger roads asks one of the railway publications for some information as to the differences in the various types of vertical plane couplers, as his road "is considering the advisability of making a change in drawbars."

Whiting Foundry & Equipment Co. and Whiting Car Wheel Co. organized, the former with a capital of $100,000 and the latter with a capital of $75,000. The incorporators are Nathan G. Moore, William B. McIlvaine and Max Baird, for both companies. Shops are under construction at Harvey, Ill.

The Big Four announces its decision to use the Pintsch lighting system on all passenger and mail cars.

H. E. J. Porter and Albert Fisher form a partnership to carry on a contracting business in the line of equipment of steel plants.

The civil engineering department of the University of Pennsylvania announces the collection of sufficient funds for the equipment of a testing laboratory to be placed in the basement of the college building.

A locomotive engineer, Ackerman by name, on the Mexican-Interoceanic, is imprisoned on account of the death of a Mexican who had been hit by his engine.

A committee of the Traveling Engineers' Association asks the familiar question: "How can traveling engineers improve the service when engines are double-crewed or pooled?"

A committee of the Master Car Builders' Association, of which E. D. Bronner is chairman, issues a circular of inquiry as to hand and air brake apparatus, with especial reference to foundation brake gear.

George Henderson is appointed master mechanic of the Butte, Anaconda & Pacific at Anaconda, Mont.

W. H. V. Rosing is appointed master mechanic of the first division, first district, of the Denver & Rio Grande at Burnham, Colo., vice Quincy Lamplugh, resigned.

The Richmond "tramp" locomotive is tested on the Chicago, Burlington & Quincy, having previously been tried out on several of the roads centering in Chicago. T. H. Symington, mechanical engineer, Richmond Locomotive Works, is in charge of the machine and is explaining its points to large numbers of railroad men each day.

The Boston & Albany decides to build shops at West Springfield, Mass.

Announcement is made of the marriage of Clarence H. Howard, secretary of the Safety Car Heating & Lighting Co.—"one of the best-known young men in the railway supply trade."

V. B. Lang, general foreman of the West Shore shops at New Durham, N. J., is appointed master mechanic of the Louisville Southern.

E. A. Hibbits is appointed master mechanic of the New York, Lake Erie & Western at Rochester, N. Y.

E. B. Gilbert is appointed master mechanic of the Pittsburgh, Shenango & Lake Erie.

Lunkenheimer brings out "the latest thing" in graphite sight-feed lubricators.

Contract is let for the new shops of the Monon at Lafayette, Ind. The town voted $130,000 to secure the location of the shops at that place, of which amount citizens advanced $50,000 pending a tax levy necessary to raise the amount.

W. E. Bentley is appointed general foreman of the shops of the Baltimore & Ohio at Zanesville, O.

H. C. Buhoup gets a patent on a railway car.

H. H. Sessions patents a car brake.

Thomas S. Reilly resigns as general foreman of the San Antonio & Aransas Pass.

Prediction is made that iron car construction has taken permanent root in this country.

W. E. Dixon is elected a director of the Rogers Locomotive Works.

A. E. Mitchell, superintendent of motive power of the Erie, denies the reported application to Erie cars of a new-fangled brake, said to set the brakes by the simple movement of the cars chucking together.

The Chicago, Rock Island & Pacific is considering the advisability of using compressed air for cleaning passenger cars, several other roads having adopted the plan successfully.

Norway begins the construction of locomotives for its roads, having formerly bought all of its equipment of this kind from Glasgow.

On account of the growing interest in the possibilities in the building of cars of steel, the Harvey Steel Car Works arrange for an exhibit of one of their steel tank cars at a convenient point in Chicago.

An Australian invents a car wheel with central flange and double tread, designed to enable equipment to pass from a line of one gauge to a line of another gauge.

James McNaughton, superintendent of motive power, Wisconsin Central, has his jurisdiction extended over the car department also, with headquarters at Waukesha, Wis.

Penny-in-the-slot electric reading lamps are introduced in the cars of the London underground railway, a deposit of a penny securing illumination for half an hour.

Massachusetts repeals its automatic coupler law of 1886 on account of the activity the railroads have displayed in equipping cars with couplers of the M. C. B. type.

THE SITUATION IN BRIEF.

Returns of the steam roads in the United States for December, reduced to a per mile of line basis and compared with the returns for December, 1912, show a decrease in total operating revenues per mile of 5.2 per cent, and an increase in operating expenses per mile of 0.1 per cent. Net operating revenue per mile was less by $61, or 16.9 per cent, than for December 1912, while that for December 1912 was 10.4 per cent greater than for December, 1911.

For the calendar year 1913 total operating revenues per mile increased 3.7 per cent, and operating expenses per mile 7.3 per cent. Net operating revenue per mile decreased $183, or 4.4 per cent, while that for the calendar year 1912 was greater than for the calendar year 1911 by 5.1 per cent. Operating income per mile decreased $239, or 6.6 per cent.

LOYALTY.

If you work for a man, in Heaven's name work for him. If he pays you wages that supply your bread and butter, work for him; speak well of him; stand by him and stand by the institution he represents. If put to a pinch, an ounce of loyalty is worth a pound of cleverness. If you must vilify, condemn and eternally disparage, why, resign your position, and, if you are a weakling, when you are outside damn to your heart's content; but as long as you are a part of the institution, do not condemn it. If you do, you are loosening the tendrils that hold you to the institution, and the first high wind that comes along, you will be uprooted and blown away, and probably you will never know why, as many have experienced.—Elbert Hubbard.

A recent notice in the "Daily Mail," of London, indicates that when the Southeastern and Chatham Railway completed its annual stock-taking it found that two locomotives were missing. Diligent inquiry discovered one of these—the article does not state where—but no trace of the other has been found. Commenting on this fact in the paper, a railway officer says that another prominent British railway, some years ago, absolutely lost six locomotives, and that its inventory reported as missing, in addition, two hundred goods wagons and fifty passenger coaches.

RAISING THE STANDARD OF EFFICIENCY IN A RAILWAY SHOP.

By Frank J. Borer.

Mark Twain, the late humorist, once said: "Training is everything; the peach was once a bitter almond, cauliflower is nothing but cabbage with a college education."

Every industrial enterprise has for its successful operation different problems to solve, which may vary to some extent according to the line of industry.

For the most part the labor problem is the most difficult one to solve. This is especially true of a railway shop. How to deal with the human element as it applies to a railway shop so as to attain a higher state of efficiency depends in no small degree upon the amount of skill and knowledge of human nature possessed and displayed by the different foremen and officers of the shops.

To raise the standard of efficiency we must cultivate the spirit of loyalty and responsibility among the employees. We must instill in them the idea that there is a mutuality of interests between employer and employees; that a railroad like any other business in order to exist and succeed must be run on paying basis, must be capable of paying interest and dividends on stocks and bonds, must make vast improvements and lay aside money for times of depression of business or for unexpected expenditures.

It has been said that a human being is a suspicious animal. There is a good deal of truth in this; therefore, it logically follows that those in charge of the force should avoid making the men suspicious or discontented, and instead use a sympathetic attitude combined with strategy and diplomacy.

Human nature is about the same the world over in regards to certain characteristics, traits or instincts. It is this instinct that those in charge of the shop force have to make the best of, have to develop or head off certain tendencies, promote those that make for education or a higher efficiency and familiarize themselves with the ability and capacity of the men. We cannot fire large bullets with a small calibre gun; likewise if large responsibilities are placed upon a small calibred individual the results of his service will be unsatisfactory or more or less discouraging. Men that have not had or could not absorb the proper training should not be expected to train others.

If we rightly put so much importance upon training or its equivalent, education, then it becomes self-evident that we must avail ourselves of the avenues open.

One of the best and most efficient methods to improve knowledge and to keep "posted" is by reading the mechanical press. Every railroad man worthy of the name should feel the need of supplying himself with reading matter conveying in a practical way a reflex of the work in which he is engaged.

Right here I will say without flattery that the *Railway Master Mechanic* deserves great credit for the pioneer work it has done relative to shop-efficiency and the unification of its forces.

But the mechanical press should not only be read or recommended to be read from a point of view of gaining knowledge by those in charge of the shop force. Every foreman should consider it his moral duty to do so.

In conjunction with reading and home study, the exchange of ideas by means of railway clubs and associations is very beneficent as an educational factor.

Being in possession of knowledge does not mean in itself that the company is going to derive any benefit therefrom. There is a tendency on the part of some foremen to "bottle up" the knowledge they have gained. Of course, this is wrong and shows them to be narrow minded. Knowledge must be put in practice, must be imparted to the men in the ranks, little by little, wherever the opportunity arises.

In every man there are certain potentialities, certain possibilities which may lay more or less dormant and which have to be developed and cultivated in the direction of reaching a higher state of efficiency.

According to the last annual report of the Interstate Commerce Commission relating to its investigation on collision accidents, 98 per cent of them had been caused by some employee failing to do his duty. Nearly the same ratio holds good in regards to accidents and personal injury occurring at the railway shops. Of course, in many instances there are a number of contributory causes that led to the accident or injuries but that does not materially alter the facts at issue. As a logical conclusion it then follows that we must aim at overcoming the faults, weaknesses and shortcomings in human nature as far as it applies to railway work, and arouse a feeling of personal responsibility, of regard for duty and a keener understanding of the interests of the employer. The task is not an easy one to be sure. An employee possessed with a spirit of apathy, indifference and lack of loyalty is not easily made into an efficient worker and it would sometimes seem far more advisable to eliminate him from the service than to try to reform him. If *all* the employees on the New York, New Haven & Hartford had done their duty that road would now not be in such a plight financially.

Biology tells us that if any living organism fails to make any progress under favorable conditions, that it will be supplanted by a better organism. The same may be said of a railroad organization or shop management. Therefore, we must ever strive for perfection, for the ideal, even though we may never reach it. The moment we lose sight of this, the moment we are contented in letting well enough alone, we not only stand still, but take a step backward. The beacon light of a shop management must be co-operation between the different departments and between the foremen and their forces, avoiding all unnecessary friction, making the environment of the men as pleasant as circumstances will permit, placing each man at the right place according to his ability and a higher efficiency of the force will follow.

JUST KEEP ON KEEPIN' ON.

If the day looks kinder gloomy
  An' your chance is kinder slim—
If the situation's puzzlin'
  An' the prospect's awful grim,
An' perplexities keep pressin'
  Till all hope is nearly gone,
Jus' bristle up, and grit your teeth,
  An' keep on keepin' on.

Fumin' never wins a fight,
  An' frettin' never pays;
There ain't no good in broodin' in
  These pessimistic ways.
Smile just kinder cheerfully
  When hope is nearly gone,
An' bristle up and grit your teeth,
  An' keep on keepin' on.

There ain't no use in growlin'
  An' grumblin' all the time,
When music's ringin' everywhere
  An' everything's a rhyme.
Just keep a-smilin' cheerfully,
  If hope is nearly gone,
An' bristle up, and grit your teeth,
  An' keep on keepin' on.

—*Exchange.*

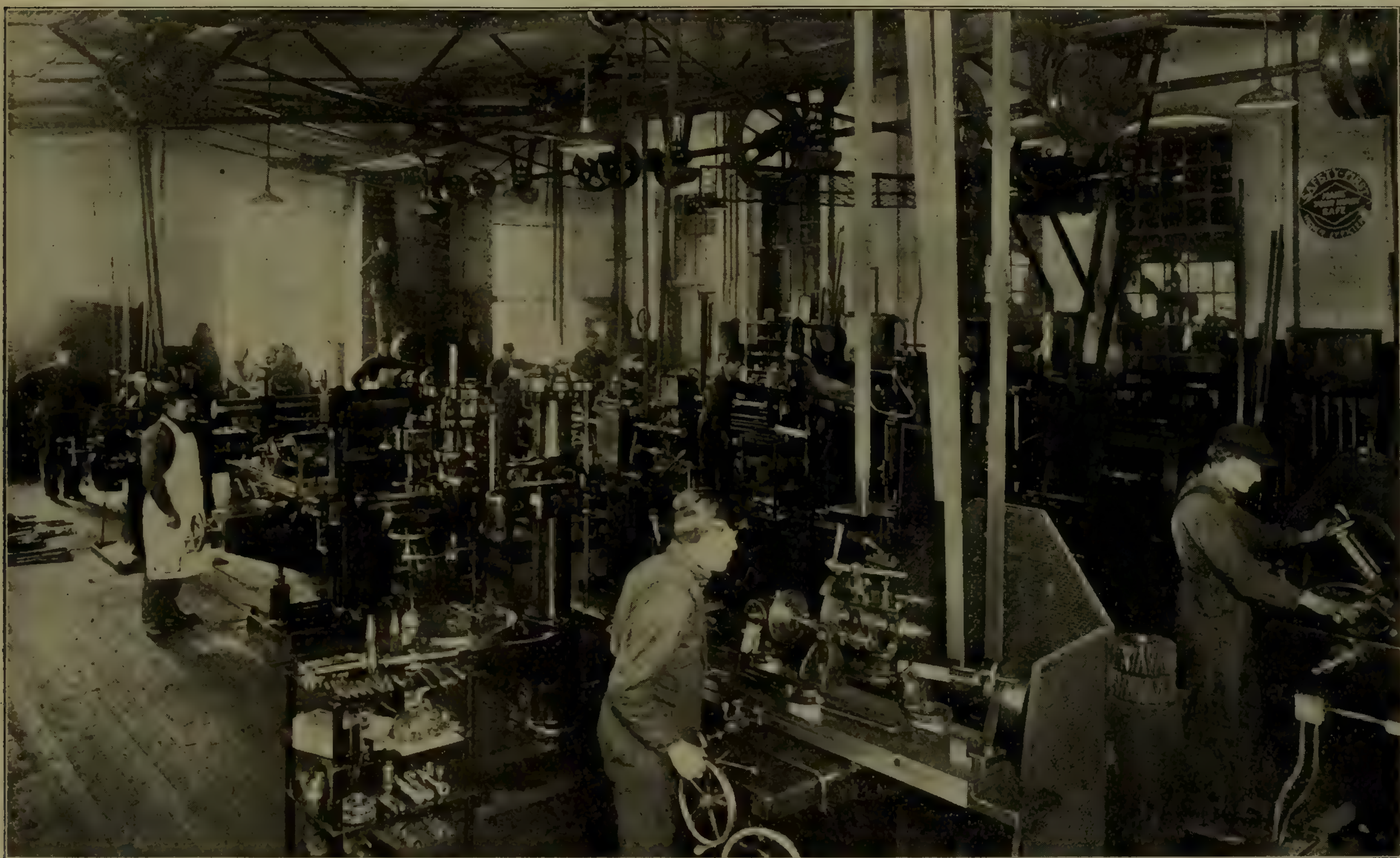
THE DYNAMOMETER CAR designed by Professor E. C. Schmidt of the University of Illniois for the Imperial Government Railways of Japan is nearing completion and will be delivered about May 1. The car is 48 feet long, 8 feet 6 inches wide and is adapted for a 3 foot 6 inch gauge with provision for changing later to a 4 foot 8½ inch gauge. It is equipped with vacuum brakes and the design of drawbars, buffers, journal-boxes, etc., conforms to Japanese railway standards. The car is of the hydraulic dynamometer type such as has been developed at the University of Illinois. The car and apparatus is designed for a maximum speed of 85 miles per hour and the recording apparatus will permit the measurements of tractive efforts up to 80,000 pounds.

A Progressive Tool Room

A MODERN TOOL ROOM, ITS EQUIPMENT AND SYSTEM FOR MANUFACTURING AND MAINTAINING RAILWAY TOOLS AS EXEMPLIFIED AT THE BURNSIDE (CHICAGO) SHOPS OF THE ILLINOIS CENTRAL R. R.

By Owen D. Kinsey, Tool Room Foreman.

The tool room organization at the Burnside shops of the Illinois Central R. R. at Chicago is new, having been developed from a careful weeding out of non-producers by substituting skilled mechanics for precision work, and specializing and training men on certain classes of work where multiple production is run through.



View of Tool Room at Burnside Shops, I. C. R. R. Note the Open Spaces Between Machines, the Safety Guards, the Tool Stands at Each Machine and the Cabinet Between the Windows. The "Safety First, Higher Efficiency" Sign Occupies a Prominent Place.

Careful attention has been given to the selection of men who are adaptable and have a progressive spirit; in other words, men who are not fixed by precedent and what they used to do "when Noah built the ark." This is a progressive age and new methods must be employed in order that we may keep pace with the times and render profitable service. The old mistaken idea of killing the job is out of date with the new order of things. It is now understood that if we cannot produce tools for less cost than same can be purchased outside, we are not entitled to, nor can we expect to, hold the work.

The writer is not an advocate of cheap labor, but believes in training and specializing workmen, advancing them up into positions of increasing responsibilities and opportunities, giving them full credit and praise for what they do and compensation according to ability and conditions; loyalty, time in service and efficiency being considered.

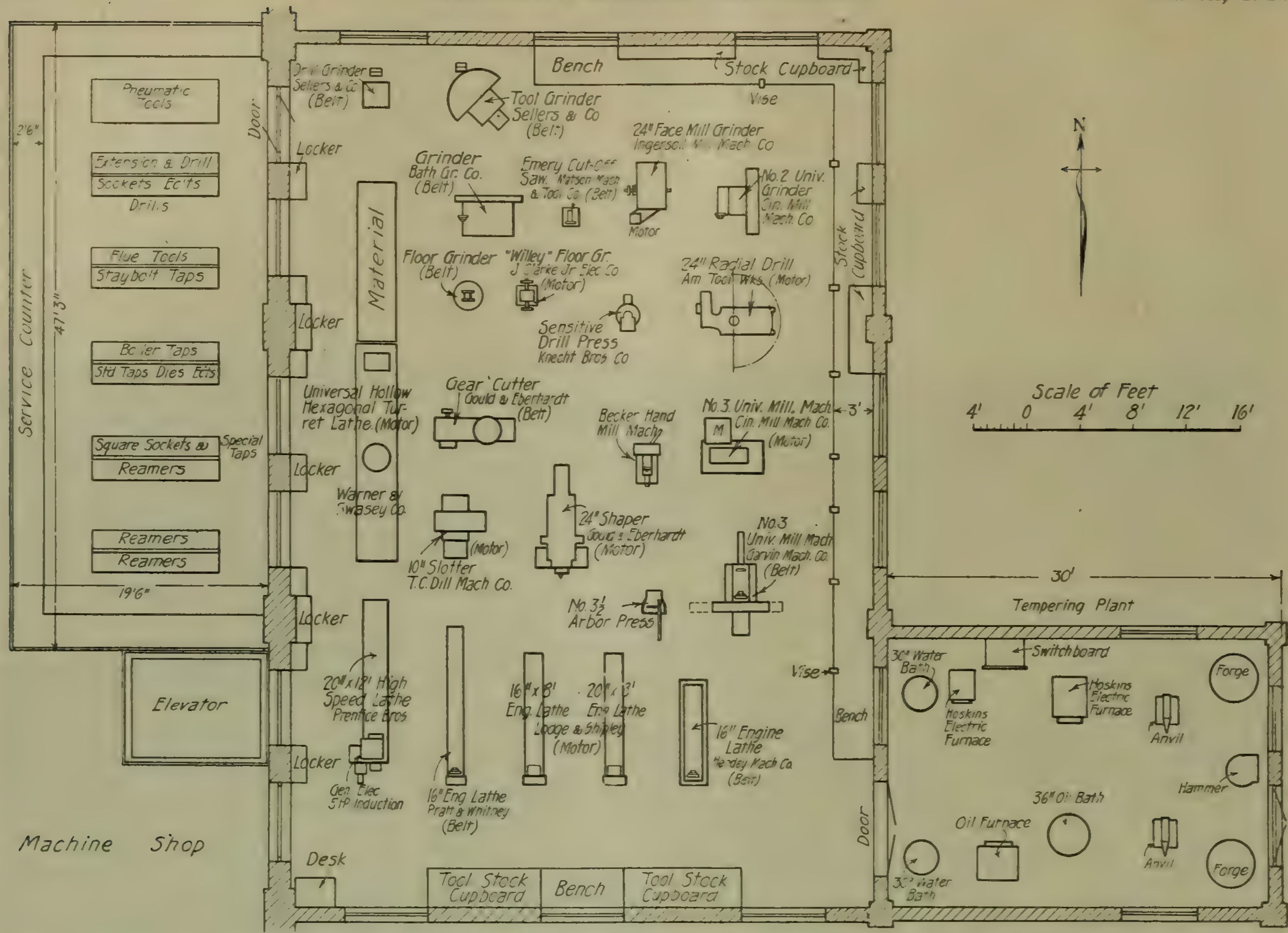
One of the illustrations shows a plan of the general lay-out of both the machinery and tool serving departments, and also the electric hardening plant adjoining. The machinery and hardening departments are located in a building adjoining the main shop. Being separate and on the ground floor, they are free from the vibration and noise of the shop.

In addition to our electrical heat treating plant, we have access to an up-to-date case hardening and heat treating plant located in the blacksmith shop, which has made possible the use of soft steel for many purposes where heretofore we had to use high-priced tool steel.

We are using punch presses for work formerly done by hand, as for instance: M. C. B. wheel defect gauges, tell-tale gauges, beading tool gauges, emery wheel dressers, etc. At one end of the room we have a tool cabinet where all new drills, taps and stock tools are kept by a system of perpetual inventory. Metal tool stands are provided for each machine and we have adopted a standard eccentric-grip tool holder for all machines, as it shows economy in the use of high speed steel.

The tool room is well lighted and ventilated, and furnishes ideal working conditions. In other words, it is a little industry by itself, thoroughly progressive, receptive to new ideas and following out a clean-cut program for betterment.

For the general lighting of the tool room twelve 250 watt Mazda lamps with 16" enameled steel reflectors are used, all spaced an equal distance apart and suspended 12 feet above the floor, thus giving an equal distribution of light to all parts of the room. These lights are entirely adequate for all general work, but a receptacle is placed on each machine for the purpose of connecting a portable light which is sometimes needed for very fine work. These receptacles also serve for connecting a



Plan of Tool Room at Burnside Shops, Illinois Central R. R. Note that the Grinding Machines Are Placed in a Group and as Far from the Percision Machines as Possible.

center grinder when required. The general lighting is arranged with two lights on a circuit so that two or more lights may be turned on or off, thus providing light for any part of the room as desired. All cut-outs and lighting switches are placed in a steel cabinet in the room.

STANDARDIZATION OF TOOLS.

All tools are manufactured from drawings which are developed by careful study of conditions and the work to be performed. The designing is done by the tool department, where the drawings are also made and standards established in accordance with requirements of the shop. All drawings are of standard folio size and are mounted on cardboard and shellaced. They, therefore, always present a clean and handy reference for the workman, place him in the position of knowing absolutely instead of guessing and enable him to perform his work more accurately and rapidly. In this connection it might be mentioned that a number of our tool room men are studying mechanical drawing and tool designing through correspondence schools and night schools, and are making commendable progress. Efforts along these lines are encouraged, and every advantage possible is given the man who produces results.

Next in importance to a standard design for all tools comes the designing and making up of special jigs and devices for facilitating accurate and rapid work. No factor is more important to economical production. A few illustrations of efficient jigs and devices are shown herewith.

Figure 1 shows a jig for drilling flue roll cages. This device handles all sizes from 1½ inches up to and including 2¼ inches. There is a graduated rule extending across the top of the sliding block, indicating the position of the drill bushing. This block can be quickly moved and locked in any position required. The upper part is hinged so that it can be raised to permit the removal of the cage and it also serves as a clamp for holding

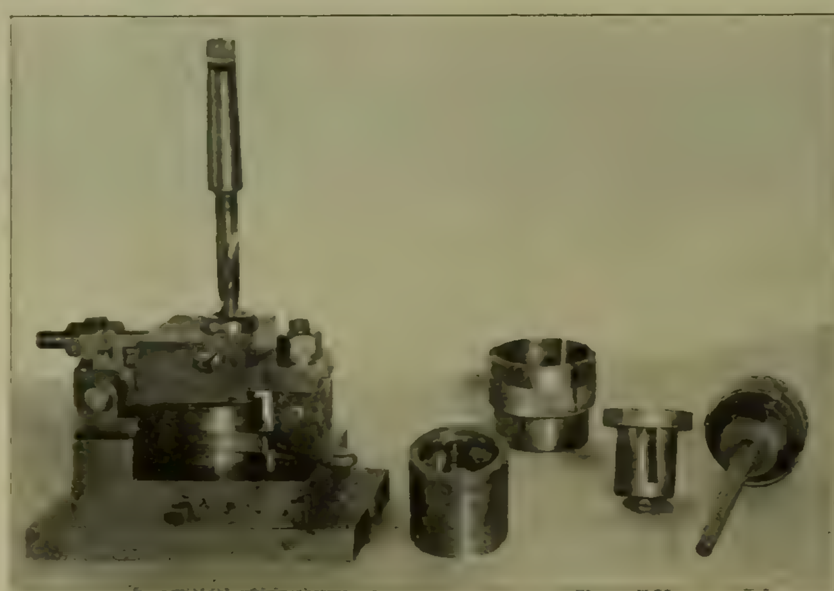


Fig. 1—Jig for Manufacturing Flue Rolls.

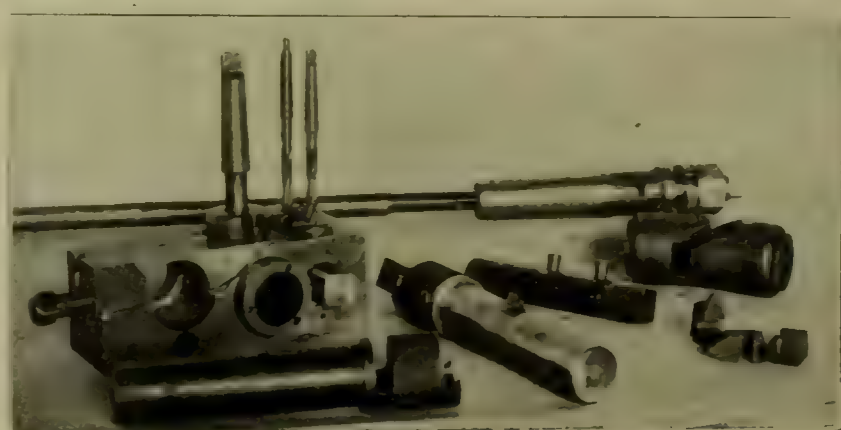


Fig. 2—Jig for Flue Cutters.

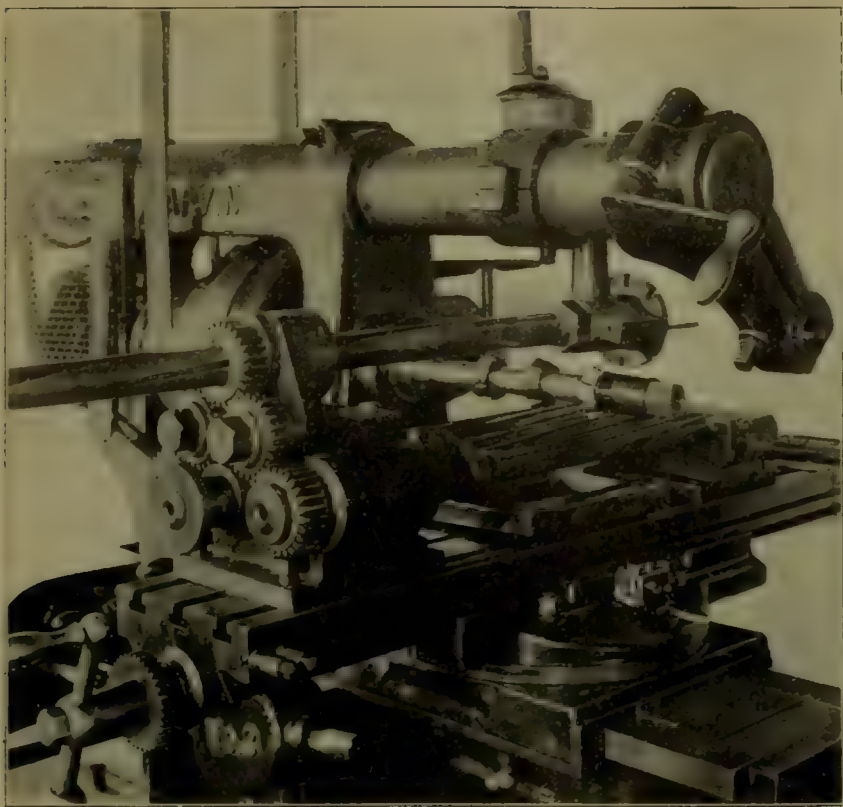


Fig. 5—Triple Head Milling Three Spiral Reamers.

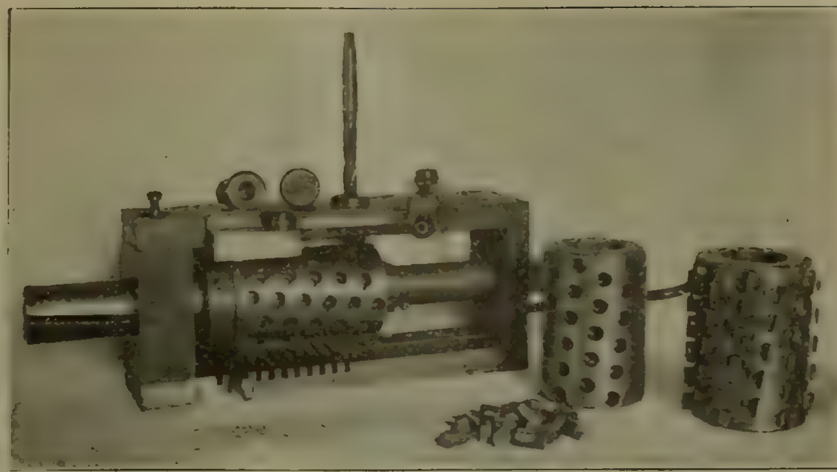


Fig. 3—Jig for High Speed Inserted Peg Milling Cutters. At the Right Is a Completed Cutter.

the cage while it is being drilled. The base plate of the jig has an inclined hole bored therein, into which the blank to be drilled is inserted at an angle of 5 degrees. The blank has three lines scribed on its circumference which are made to coincide with zero line on base. Two specimens of work are shown to the right of jig, one piece as it comes out of the jig and the other after having been turned in a lathe. A completed tool is also shown. This drilling is accomplished by an inexperienced man at an average rate of 25 minutes per piece. The material used is machine steel which is case hardened and heat treated. The rolls and pin are tool steel.

Figure 2 shows a jig in which we manufacture our standard flue cutters, this device being used on three machines, namely: Drill press, slotter and milling machine. A complete flue cutter may be observed to the right of jig. The barrel is made of machine steel, case-hardened and heat-treated. The plunger and cutter are made of tool steel and hardened.

In the background is shown a device for machining flue cutter knives. This device fits in spindle of lathe. The outer end is similar to a flue cutter, into which the blanks are inserted and turned to correct length and radius, making a very efficient and inexpensive cutter. We remove 6,000 to 7,000 flues per month at Burnside shops and positively have no trouble with this style of cutter. We cut a complete set in from one and one-half to three hours, including the setting up of the machine.

Figure 3 shows a drilling jig for spacing, drilling and reaming the blanks for high-speed, inserted peg milling cutters. The blank to be drilled is locked on an arbor which extends through the housing. This arbor has a spiral key-way extending thereon and a floating key projects into same through left housing, causing the arbor and blank to twist spirally as they are moved to different drilling positions. The key-ways in the base plate space the pegs lengthwise while changing the key, shown extending out of end of blank, into different key-ways in arbor divides the circumference.

The first operation is to drill 7/32" dowl pin holes and then change bushing and drill and ream. The object of the dowl pins is to keep pegs from turning when under severe stress and also keep cutting edges dead in line as pegs are driven into place. The pegs are milled in a jig, and a 7/32" drill rod is used for the dowl pins. A finished cutter ready for grinding is shown to right of jig. A number of pegs are also shown in the foreground. The jig shown is for cutters used on a vertical milling machine which mills all rods and motion work.

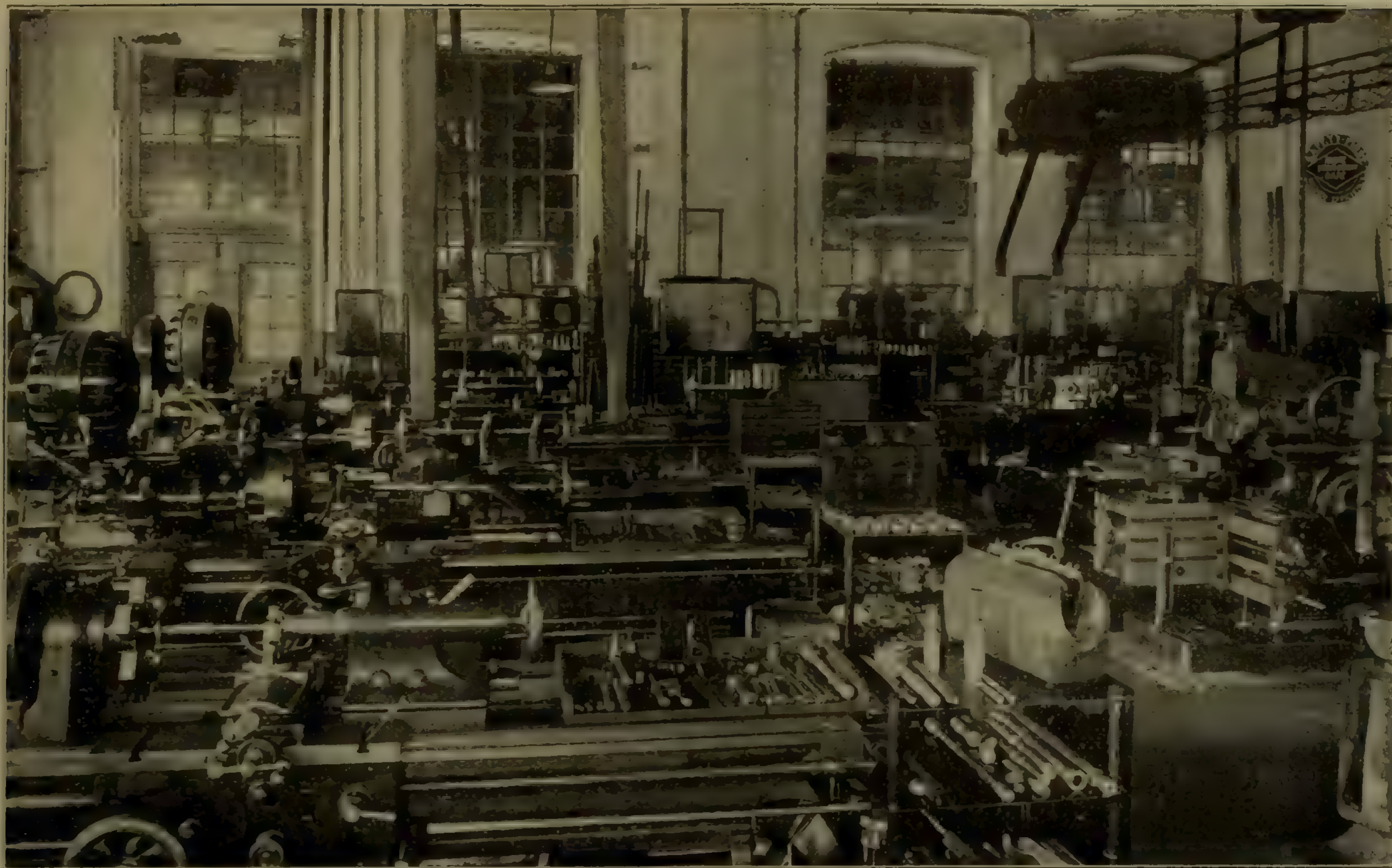
The objects in Figure 4 are jigs and tools used in manufacturing standard drill sleeves and all other tools having Morse taper shanks.

Figure 5 shows a triple milling device milling three spiral

Fig. 4—Tools and Jigs for Manufacturing Drill Sleeves.

Fig. 6—Group of High Speed Milling Cutters Made at Burnside Tool Room.

Fig. 7—Some of the Tools Made at the Burnside Tool Room of the Illinois Central R. R. Showing also the Pans Used for Conveying and Handling Small Parts.



View Looking West, Showing Tool Room Lathes, Shaper, Slotter and Turret Lathe.

reamers at one operation. The dividing head may be observed under and to the right of the overarm. The three spindles in the triple head are revolved by the main drive gear, being advanced along the stationary shaft mounted above and parallel to table. This shaft has two key-ways extending thereon, one being straight and the other spiral, permitting either straight or spiral reamers to be made. We also use this device for sawing three sectional flue expanders at one time.

Figure 6 shows a group of modern high-speed milling cutters as adopted for tool room work. Attention is called to wide spacing of the teeth of milling cutters and our designs for heavy duty end facing mills. The shape of cutters are patterned after the recommendations of the Cincinnati Milling Machine Co. The taper, however, has been shortened from the standard B. & S. taper to our own standard of 3" in twelve. This may be particularly noticed on the cutter at extreme right of the illustration. The shanks and method of holding same are our own designs. The output of the milling machinery in the shop has been materially increased by the use of the efficient cutters above mentioned.

Figure 7 shows tools we have manufactured. All work in process of manufacture is handled in metal pans or trays, which is in keeping with the general system typical of the new order of things.

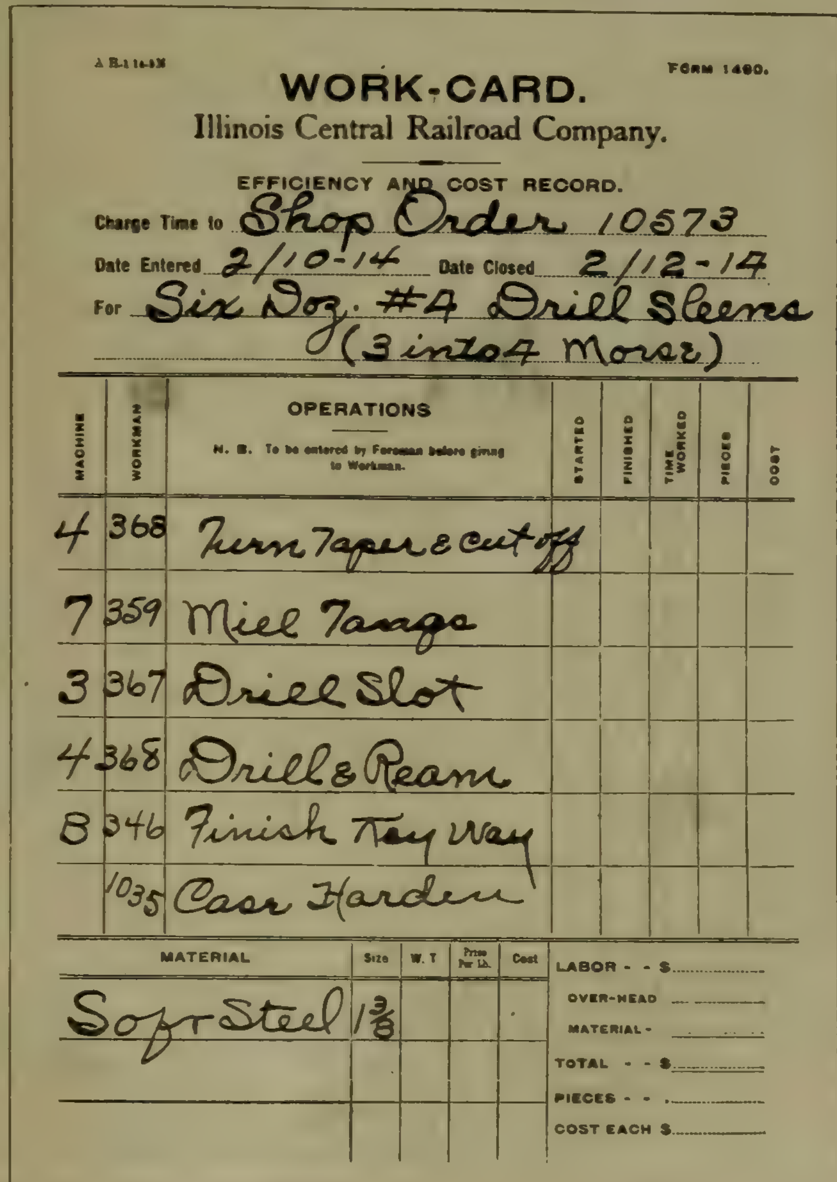
To the left in this illustration are a number of twist drills which have been fitted with larger size sockets and fastened by a pin which will shear under excessive stress, preventing loss of drill. We use the same scheme on all square sockets, it having proved a very efficient safety device.

Also may be noted our standard high-speed inserted blade rose reamers, improved high-speed counter-bores, etc.

COST ACCOUNTING.

One of the illustrations shows a facsimile of our work card, which is an efficiency record of each workman as well as a cost record. The card shown covers the manufacture of six dozen No. 4 Morse taper drill sleeves. Each operation to be performed is entered on the card by the foreman, also the time started, time finished and number of pieces turned out. This particular order was handled as follows:

First to the turret lathe, where tapers were formed to gauge at an average speed of 4 minutes per piece for the entire run. The stock was 1⅜" common soft steel. A roughing cut was taken at a spindle speed of 125 r. p. m. with a turret advance of 13⅜



FORM 1460.

WORK-CARD.

Illinois Central Railroad Company.

EFFICIENCY AND COST RECORD.

Charge Time to Shop Order 10573

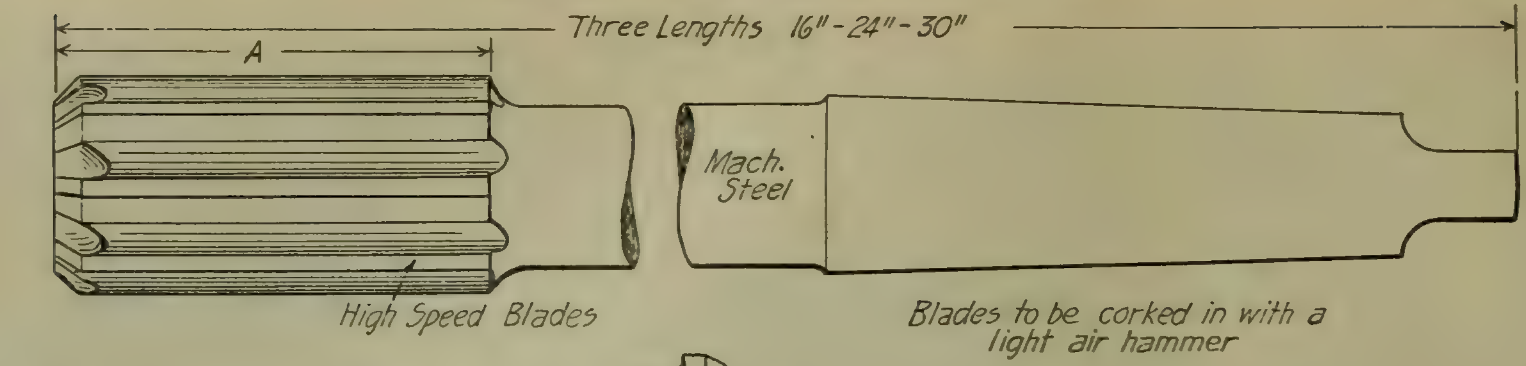
Date Entered 2/10-14 Date Closed 2/12-14

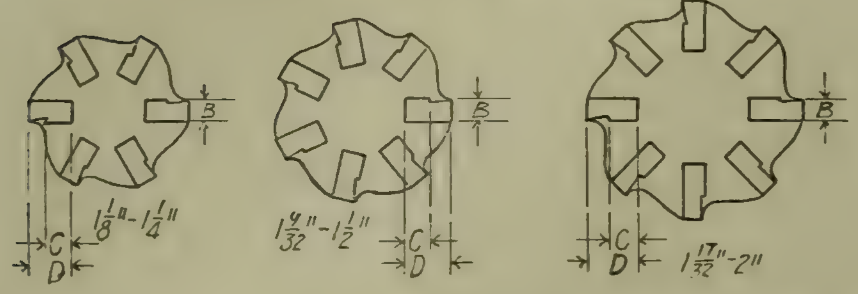
For Six Doz. #4 Drill Sleeves (3 into 4 Morse)

MACHINE	WORKMAN	OPERATIONS N. B. To be entered by Foreman before giving to Workman.	STARTED	FINISHED	TIME WORKED	PIECES	COST
4	368	Turn Taper & cut off					
7	359	Mill Tange					
3	367	Drill Slot					
4	368	Drill & Ream					
8	346	Finish Key Way					
	1035	Case Harden					

MATERIAL	Size	W. T	Price Per Lb.	Cost
Soft Steel	1⅜			

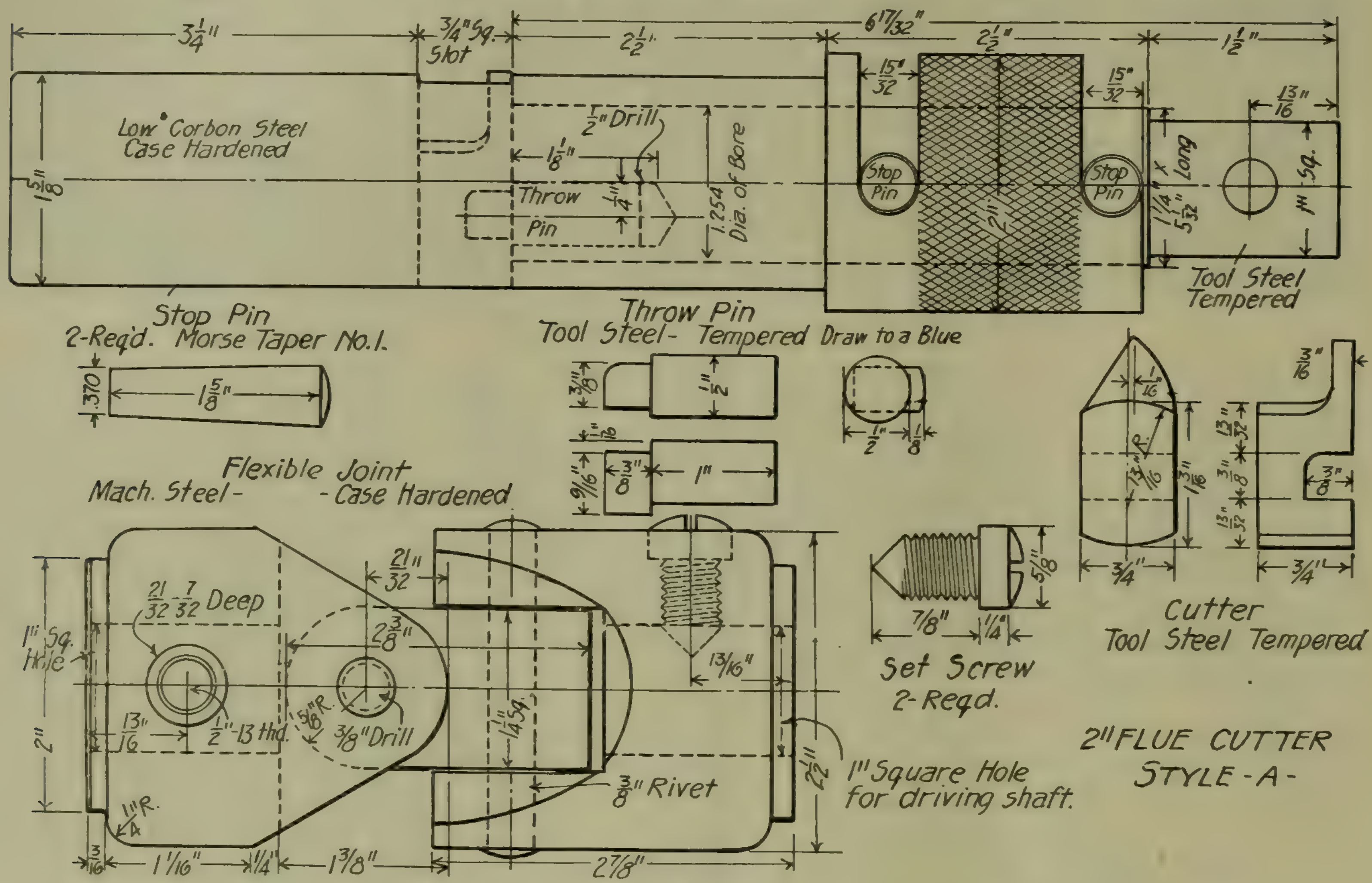
LABOR - - $
OVER-HEAD
MATERIAL -
TOTAL - - $
PIECES - -
COST EACH $



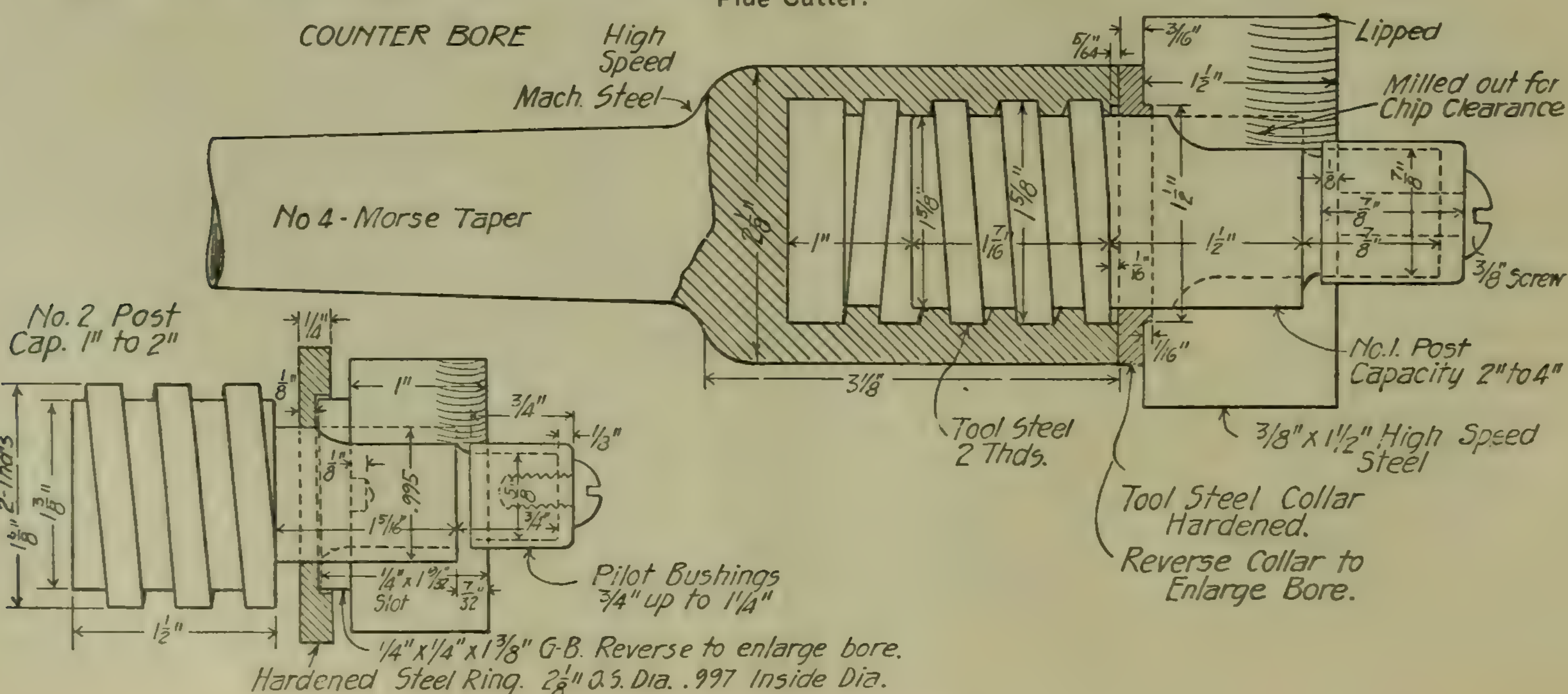


Size of Reamer	Shank	A	B	C	D	No. Blades
1 1/8" to 1 1/4"	No. 4	2 3/4	5/32	5/32	9/32	6
1 9/32" to 1 1/2"	No. 4	3	5/32	11/64	5/16	7
1 17/32" to 2"	No. 4	3 1/2	5/32	3/16	11/32	8

High Speed Rose Reamers.



Flue Cutter.

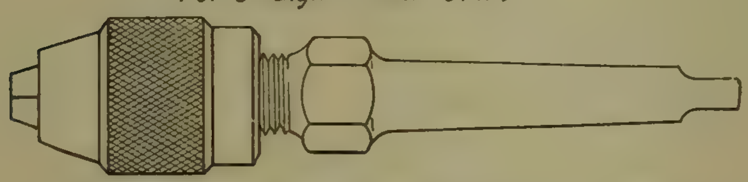


High Speed Counter Bore.

inches per minute, which was equal to .107" feed advance for each revolution of stock. The box forming tool operated against a spindle speed of 50 r. p. m. and turret advanced 5⅜ inches per minute, which was equal to .107" feed advance for each revolution of stock. The cutting blades were not ground during the entire run. Tapers were cut off at 125 r. p. m.

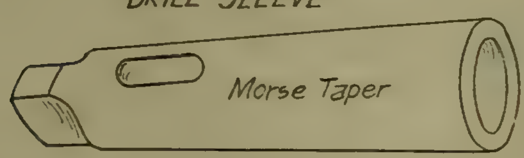
Second, to milling machine, where an old gentleman milled

DRILL CHUCK
For Straight Shank Drills



Catalogue No.	Capacity Inches	Shank	Price
A-1	0-to 1/4	No. 1 Morse	
A-2	0-to 1/4	No. 2 Morse	
A-3	0-to 1/4	For No. 10 Thor Motor	
A-4	1/4 to 1/2	No. 3. Morse	
A-5	1/4 to 1/2	No. 4 Morse	

DRILL SLEEVE



Catalogue No.	Inside Number	Outside Number	Price
A-6	1	2	
A-7	1	3	
A-8	2	3	
A-9	2	4	
A-10	3	5	
A-11	4	5	

Page from Catalog of Standard Tools.

the tangs at an average speed of 2 and 7/10 minutes per piece on the entire lot, using H. S. Straddle mills and special clamping device.

Third, to drilling machine, where a boy drilled key-way.

Fourth, back to turret lathe, where tapers were drilled, rough reamed and finished reamed with high-speed spiral reamers at an average time of 10 minutes each.

Fifth, to bench, where key-way was drifted out and tapers finished ready for case-hardening, completing the job.

A B-1-14-5M FORM 1461.

TOOL CLEARANCE CARD.

Illinois Central Railroad Company.

(IN ALL CASES WHERE A TOOL IS LOST, DAMAGED OR BROKEN THIS CARD MUST BE FILLED OUT.)

Date Jan 30-14

Bearer John Doe 5073
(Name) (Check Number)

HAS Worn Out / Damaged / Broken / Lost — Drill 3/4
(Full Name of Tool) (Size)

AS A RESULT OF Defective Material / Accident / Ignorance / Carelessness

GANG FOREMAN. SHOP FOREMAN.

GENERAL FOREMAN TOOL FOREMAN

In addition to our standard folio of detail drawings, we have a catalog illustrating and listing under a symbol number all standard tools made at Burnside. We also have a tool steel folio which specifies the grade of steel to be used for every class of work. Different grades of steel are identified by standard color marks or stripes painted the full length of bar, a plan which eliminates mistakes in the selection of the correct grade desired.

SYSTEM OF CHECKING TOOLS TO WORKMEN.

Every department has a certain series of time check numbers, which are further subdivided between the gang foremen. A book is kept in the tool room listing each gang foreman separately and his series of numbers. Suppose a new man is started to work in the boiler shop. After being assigned his time check number and turned over to his gang foreman, he is then sent to main tool room for a set of tool checks and a tool kit. Six checks are issued to him corresponding with his time check number and his name is entered after same number in book. Certain tools required by him are listed on a special form, a copy of which is given to him, while the original is filed in the tool room. These lists are checked from time to time and in event he leaves the service the tools must be returned, also tool checks and a clearance obtained from tool room before time will be given.

Our rule is that all tools must be returned to the tool room each night unless ordered held on job by gang foreman and notice given to tool room, which is recorded.

Tools are classified and arranged in sections. Each section has a separate check board listing all tools therein and a tool tender for each section, who is held responsible for all tools in his care. In case a tool is lost, damaged, worn out or broken, a clearance card must be filled out and properly signed by gang foreman, department foreman and tool foreman before it will be accepted by window tender and check released.

A night man regularly oils all pneumatic tools and cleans air hammers by washing them out in a coal oil bath every night. He also makes up a list of all checks shown on check board each night and, after checking off the numbers of men who have been allowed to hold tools out, makes up a list which is sent to gang foreman on the following morning. If the same number appears the following night, it is then reported direct to the department head and business picks up for all concerned.

This system has been in force for over a year and is followed up to the letter, with highly beneficial results.

The success so far attained is due to the hearty and untiring coöperation of a progressive shop superintendent, general foreman and general inspector of tools.

WESTINGHOUSE ELECTRIC VETERANS ORGANIZE.

On Saturday evening, February 21, the employees of the Westinghouse Electric & Mfg. Co. who have been in its employ for a period of twenty years or more, held a meeting and organized the Veteran Employees' Association of the Westinghouse Electric & Mfg. Co. A regular business meeting was held to formulate the organization and a set of by-laws were adopted, and officers were elected for the ensuing year.

Following a dinner, an interesting program was carried out, consisting of speeches and vaudeville. The toastmaster was L. A. Osborne, vice president of the Electric Company.

A striking fact was the youthful appearance of these so-called veterans, as the majority of the crowd appeared to be men in the prime of life. About 325 employees of the Electric Company are eligible to membership, and approximately 315 of these were present at this meeting. Nor were all these of the male sex, as there was also one woman present, she being a forelady in the retail division of the shop.

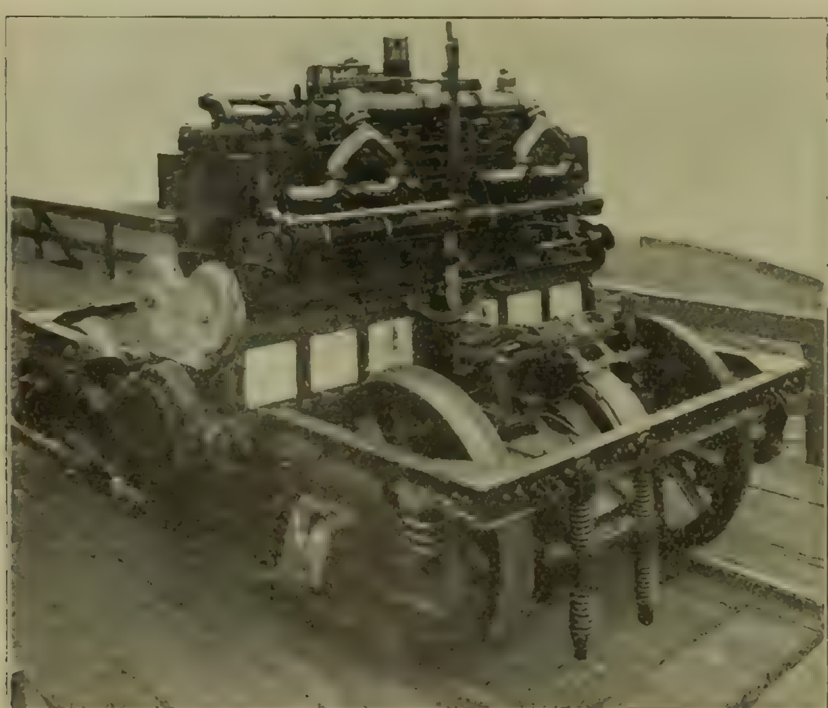
The speakers were: E. M. Herr, president; Chas. A. Terry, vice president, and Jas. J. Barrett, representing the shop.

NEW DESIGN McKEEN MOTOR CARS, SUNSET-CENTRAL LINES.

New model McKeen gasoline motor cars (Type "C") have been built for and delivered to the Morgan's Louisiana & Texas, Galveston, Harrisburg & San Antonio, and Houston & Texas Central. One of the new cars and front truck are herewith illustrated, from which it will be noted that the car body is practically identical with the original design of the McKeen standard car, the tri-unit of operation principle being: (1) vehicle, car body; (2) prime mover, internal combustion engine; and (3) mechanical transmission. With this mechanical transmission, said to be of 96 per cent efficiency, a transfer to the driving wheels of 96 out of every 100 H. P. of the crank shaft renders improvement of transmission efficiency improbable.

McKeen Gasoline Motor Car (Improved Design), Sunset-Central Lines.

While the latest model motor truck maintains the McKeen standard motor car principles, the new design is the result of nine years' experience in the manufacture of these cars and combines the collective experience of fifty odd railroads using this equipment. While the new car is of no greater efficiency its up-keep and maintenance charges are materially reduced. A seven-year-old car recently made the attractive record of covering over 5,000 miles during the month, earning $117 per day at a total operating charge of 14 cents per mile. The gasoline engine is really a motor, entirely enclosed and practically fool proof; the machinery is self-lubricated, operates automatically as far as practicable, the idea being to eliminate almost entirely the personal equation in operation.



New Design of McKeen Standard Power Trucks.

The chief features of the new power truck are:

Integral steel casting side frames.

M. C. B. wheels and axles.

New design driving box permitting its removal without dropping the wheels.

Machinery and all moving parts enclosed in oil tight, dust-proof, fool proof casings and housings.

Crank shaft, cam shafts, bearings, rods, air pump, water pump, etc., automatically lubricated by an improved circulating oiling system, in which the lubricant repeats its circuit continuously, with minimum loss.

Manifold pipes, water jacketed by means of which the gases are heated and equally distributed to the different cylinders.

Increased water space around valves and cylinder heads to permit of overloading the engine.

Valves of Tungsten steel.

Special design of triple piston ring.

New location of the throttle and spark levers rendering them particularly convenient and within easy reach of the motorman.

New design of mechanical transmission: a multiple disc friction clutch which with the increased number of friction elements gives more positive action and greater efficiency, the larger friction surface reduces the rate of wear and the life of the clutch is obviously enormously prolonged.

Speed gears of transmission have been proportionately increased in strength, the herringbone type gear is used instead of the ordinary involute spur gear.

General specifications of the Sunset-Central cars are:

Engine, 200 H. P., McKeen standard, six cylinder, air-starting and reversible.

Weight of car in working order, 78,000 lbs.

Length between pulling faces of couplers	72′—3¾″
Length over end sills	70′—0″
Length of engine compartment	13′—8″
Length of baggage compartment	8′—6″
Length of smoking compartment	16′—4⅛″
Length of passenger compartment	28′—0⅞″
Width inside	9′—4¾″
Width over side sills	9′—8″
Width over sheathing	9′—8¼″
Width over all	10′—2¾″
Height, top of rail to top of car (light)	11′—9-3/16″
Height, floor to ceiling at center of car	7′—5⅝″

Seating capacity, passenger compartment, 54; smoking compartment, 29. Total, 83.

THE RAILWAY STOREKEEPERS' ASSOCIATION will hold its eleventh annual convention at the Hotel Raleigh, Washington, D. C., on May 18, 19 and 20, 1914.

BRAKE PERFORMANCE TESTS.*

By S. W. Dudley, Asst. Chf. Engr., Westinghouse Air Brake Co.

Realizing the significance of the knowledge and experience accumulated in recent years, the Pennsylvania Railroad, in conjunction with the Westinghouse Air Brake Company, instituted in the spring of 1913 the most scientific and comprehensive investigation of the different factors affecting the operation of brakes on steam railroad passenger trains that has been undertaken since the Galton-Westinghouse trials of 1878 and 1879. In addition to an examination of the characteristics of brake shoe friction throughout a wide range of laboratory and operating conditions, the test included also a study of the effect of various types of air brake mechanisms and foundation brake rigging and different degrees of emergency braking force.

The tests indicated the degree to which existing apparatus was suited to existing conditions, the direction in which improvement was necessary and could be made, and the amount of improvement actually accomplished. All of the information is available in the official report of the tests compiled by the test department of the Pennsylvania Railroad, copies of which may be obtained from the Westinghouse Air Brake Company.

The limitations of the old brake apparatus are most marked in the following particulars: In the length of emergency stops; the uniformity of brake applications on different vehicles comprising the train; the safety and protective features demanded by service conditions of great severity and complexity; the flexibility and certainty in applying and releasing the brake during service application; and the increased difficulty of keeping the service and emergency functions separate, i. e., insuring quick action when required on the one hand, and preventing it, when not required on the other.

*Introduction and conclusions of a lengthy paper delivered before the American Society of Mechanical Engineers on February 10, 1914.

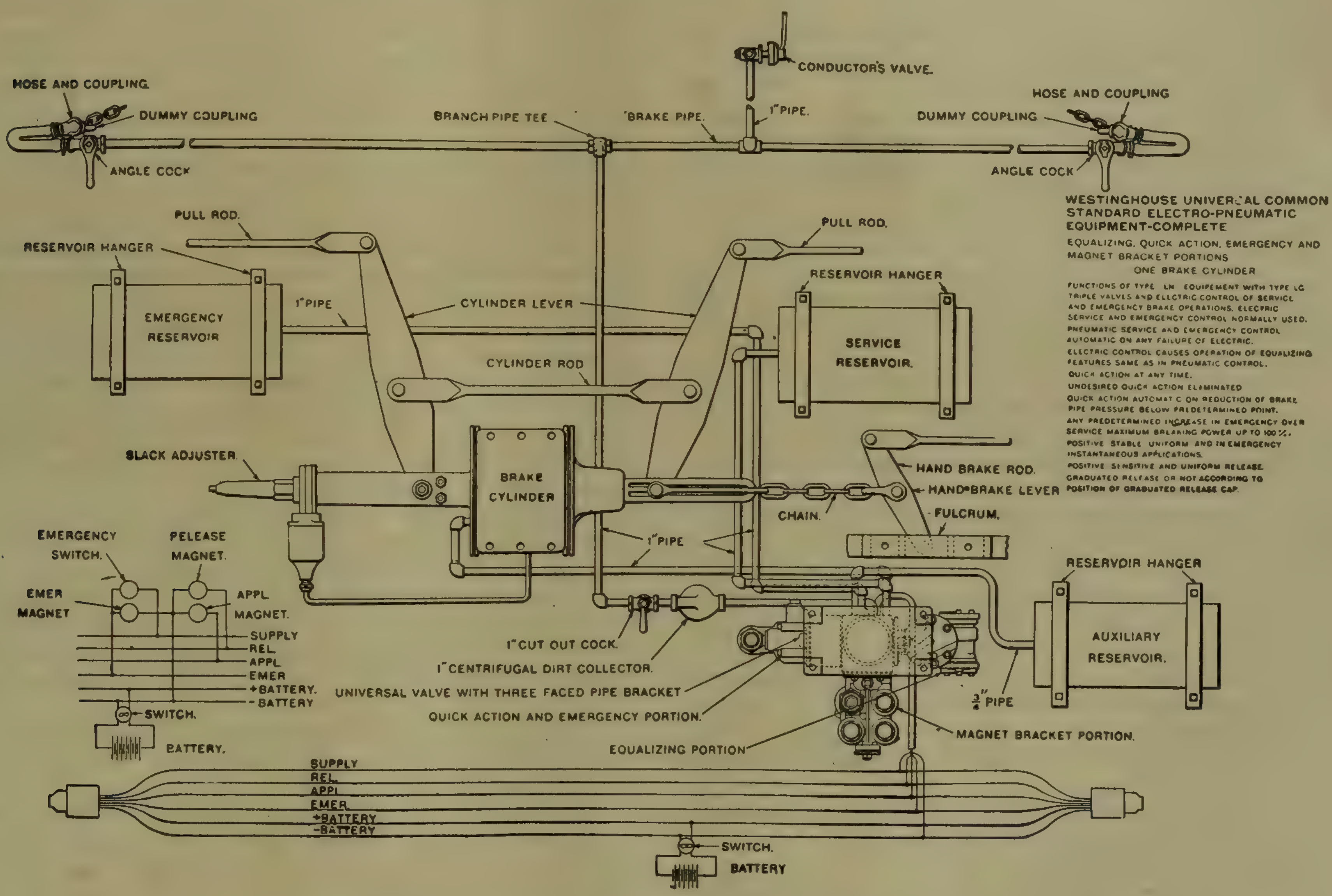
In considering the improvements desirable in the above particulars four factors require special attention:

A. The characteristics of the mechanism available for controlling the pressure of the compressed air in the brake cylinders.

B. The efficiency of the mechanical transmission of the force of compressed air developed in the brake cylinders, through the rods and levers of the brake rigging to the brake shoes.

C. The efficiency of the brake shoe in transforming the pressure imposed upon it into retarding force at the rim of the wheel.

D. The available adhesion between the car wheels and the rails.



The UC Equipment, Giving a Diagram of the Complete Electro-Pneumatic Brake.

The Galton-Westinghouse brake trials on the London, Brighton and South Coast Railway in England during 1878, constituted the first scientific investigations of the action of brake shoes in retarding the motion of railway vehicles. They have occupied a unique position in the railway art, as the classical and in fact, the only source of information regarding the characteristics of brake shoe friction under certain typical road service conditions.

But the conditions under which these experiments were conducted represented an early state of the art when much lighter cars, simpler mechanisms and lower braking pressures were used than has been common practice in this country for many years. In consequence of this, although the results of the experiments remain conclusive and fundamental as to general principles involved, they are far removed, in degree, from modern railroad train operating conditions.

The Lake Shore emergency brake tests of 1909, which appear in the Master Car Builders' Association Proceedings for 1910, directed special attention to the important influence of the foundation brake rigging and brake shoe performance as affecting the stopping of modern heavy rolling stock. These

tests showed clearly the necessity for realizing, as nearly instantaneously as possible, a retarding force as high as the limitations of track and equipment would permit, if emergency stops, especially at high speeds, were to be made in as short a distance as desirable.

There are four factors which have a controlling influence on the length of stop: (1) the maximum brake cylinder force; (2) the time in which this is obtained; (3) the efficiency of the foundation brake rigging in multiplying and transmitting this force to the brake shoe; (4) the mean coefficient of brake shoe friction.

The object of the Pennsylvania Railroad tests of 1913 was to make as thorough a study as might be found practicable of the variables mentioned above and their effects, with particular reference to:

A A determination of the maximum percentage of emergency braking power which can be adopted, considering:

- a The type of brake shoe to be used
- b The type of brake rigging to be adopted
- c The type of air brake mechanism and control to be adopted
- d The degree to which occasional wheel sliding is to be permitted under unfavorable circumstances
- e The variation in the condition of the rail surface for which it is considered necessary to provide

B A comparison of the relative performance of the clasp brake rigging (two shoes per wheel) and the standard brake rigging (one shoe per wheel) with regard to:

- a Maintenance of predetermined and desired piston travel
- b Efficiency of transmission of forces
- c Effect upon wheel journals, bearings and trucks
- d Mean coefficient of brake shoe friction for the standard plain cast iron shoe

C A comparison of the performance of the improved air brake mechanism (type UC) with that of the commonly used "high speed" (type PM) brake equipment with regard to:

- a Efficiency and effectiveness, as shown by the length of service and emergency stops
- b Safety and protective features
- c Flexibility and certainty of response to any manipulation of the engineer's brake valve
- d Uniformity of action of individual equipments associated in the same train and of any individual equipment at different times
- e Smoothness of riding during stopping, slack action between cars, and the resulting shocks
- f Capacity for future requirements

D The behavior of the brake shoes as the tests progressed and any variation in the results of similar tests, which could not be accounted for by known changes independent of the brake shoe. One type of brake shoe was to be used throughout the range of the tests. Relating to objects A, B and C, advantage was taken of this opportunity to establish as definitely as possible the characteristics of this type of brake shoe under the influence of various combinations of speed, pressure, time, weather and the conditions of the brake shoe.

E The coefficient of friction between the wheel and the rail under varying weather conditions.

In addition to the investigations outlined in general above, it developed during the tests that additional data were desired regarding the performance of brake shoes under certain specific conditions. In consequence a series of experiments was carried out at the laboratory of the American Brake Shoe and Foundry Company, at Mahwah, N. J.

From the outset of the tests an endeavor was made to obtain data and develop methods by which the performance (as to stopping when placed in service) of any given air brake apparatus and its related equipment, could be predetermined on the basis of the observed action of the individual elements which go to make up the whole.

It will be seen that the desirable stopping distance of 1200 feet may be obtained by improvement in some or all of the controlling factors, namely, the type of air brake mechanism, the foundation brake rigging, the nominal percentage of braking power, and the type of and condition of the brake shoe. Furthermore, a stop of 200 ft. or more shorter than this can be obtained when all the elements having an influence on the length of stop are disposed in the most favorable manner possible.

In proportion as the efficiency of any one or more of these factors can be increased, that of the others can be correspondingly reduced so that a lower maximum can be employed for the remaining factors when circumstances render this desirable. For example, the reduction in the time of action, secured by the use of the electric control of the brakes, increases their effectiveness and makes a shorter stop possible, thus permitting the use of braking power 30 per cent less than is required with a less effective brake for the same stop.

The tests of the standard (type PM) air brake equipment were planned to determine the characteristic performance of this type of equipment throughout the range of service and emergency operating conditions typical of the ordinary service in which this equipment is in general use. Inasmuch as experience has shown that under the severe requirements of today the type PM equipment lacks many of the features which are necessary to obtain a desirable degree of stopping power in emergency applications and prompt and certain response at all times in ordinary service brake manipulation, one of the objects of the tests scheduled for this type of equipment was to bring out its limitations and serve as a standard of reference to measure the betterment made possible by the improved features of the new air brake apparatus, the more efficient design of foundation brake rigging and more satisfactory brake shoe performance.

The special features of the improved air brake equipment (type UC) which received more or less attention during the tests may be summarized as follows:

A The electro-pneumatic brake equipment is adapted to meet any requirement, from that exemplified in the PM brake equipment to the more exacting requirements of present conditions, with a degree of efficiency as high as the existing physical conditions will permit.

B Considering cylinder pressure alone the equipment may be installed so as to produce any desired pressure, either in service or in emergency.

C The gain by use of the electric control, in addition to the pneumatic, is the elimination of the time required for the pneumatic transmission of the action of the brake from car to car and in addition the elimination of shocks and uncomfortable surging which results from the non-simultaneous application of the brakes on all cars.

It is apparent that the gain from the electro-pneumatic control is not so much in the shortening of the stop, particularly in emergency, as it is in the increased flexibility and certainty of control of the brake and the assurance that modern long heavy trains can be handled smoothly and accurately.

D The troubles and inconveniences due to brakes failing to release, as well as the undesired application of brakes due to unavoidable fluctuations of brake pipe pressure when running over the road, are eliminated.

E An adequate supply of air is available at all times.

F The emergency braking power is available at any time, even after a full service application of the brake, since it is impossible for the engineman to use up the reserve emergency pressure without making an emergency application.

G The equipment is adaptable to all weights of cars and to any desired percentage of braking power. Two brake equipments for heavy cars are not necessary nor are two service brake cylinders required, except for cars weighing more than the limit of the service capacity of one brake cylinder. Provision is made for using one brake cylinder up to the maximum percentage of emergency braking power which it can provide,

and for using two cylinders when a higher emergency braking power is desired. When using one brake cylinder, the maximum service pressure is controlled by means of a safety valve. When two cylinders are used, equalizing pressure from 110 lb. brake pipe pressure is utilized for the service brake (instead of blowing the air away at a reducing valve) and another brake cylinder is used for the additional power required in emergency applications. The use of one or two cylinders is optional, depending upon the amount of braking power to be employed.

Duplicate tests were made with the clasp brake rigging, two shoes per wheel, for every test made with the standard brake rigging, one shoe per wheel, in order to bring out the advantages of the clasp brake in the following desirable features: (A) constant piston travel for all cylinder pressures; (B) smoothness of action during stopping; (C) greater certainty of obtaining and maintaining the predetermined braking force contemplated in the design of the air brake equipment and foundation brake rigging; (D) less displacement of journals, bearings and trucks, tending toward greater mechanical efficiency and less cost of maintenance; (E) a coefficient of friction equal to or greater than that with the single shoe brake with less wear of brake shoe metal and lower wheel and brake shoe temperatures.

The original plan contemplated two 12 car trains of standard P-70 cars. These cars have 4-wheel trucks with one 16-in. brake cylinder per car. One train was equipped with the clasp type of brake rigging (two shoes per wheel) and the other with the type of standard brake rigging (one shoe per wheel) existing on these cars since they were built, but modified by increasing the strength of the members to be suitable for 180 per cent braking power which necessitated lowering the brake shoes 1⅛ in. below their former position and by anchoring the truck dead lever to the car body, instead of to the truck.

In order to obtain the best data possible, instruments were devised for taking records of the friction of the rail, wheel sliding, retardation of the train, and slack action between cars as well as for a number of minor observations.

The test train was 1040 ft. long, consisting of a Pacific type locomotive and tender of the P. R. R. K2s class, weighing in working order about 200 tons, and 12 P-70 steel passenger cars averaging about 61 tons each.

The ET air brake equipment was used without any modification on the locomotive, except that in some tests an auxiliary device was used which increased the braking power obtained during the early portion of the stop.

All tests were made under road service conditions, except where otherwise noted, the air brake regulating devices on the locomotive and cars being adjusted as follows:

Pump governor, low-pressure head 130 lb. Maximum pressure head 140 lb.

Feed valve, 110 lb.

ET distributing valve safety valve, 68 lb.

The cars were equipped with the present standard air brake apparatus (PM) and with the improved type of air brake equipment (UC), these installations being so arranged that a complete change from the standard equipment (PM) to the new equipment (UC) having PM features only or the complete pneumatic features of the new equipment or to the new equipment with complete electrical control could be quickly made.

The standard plain cast-iron brake shoe was used in most of the tests. In several tests flanged, slotted and half area shoes were employed. Special care was taken to insure uniformity in quality and the condition of all shoes at the beginning and during the progress of the tests.

The high-speed reducing valves of the PM equipment were adjusted to open at 62 lb. brake cylinder pressure.

The standing piston travel was adjusted before each run to 6½ in. with a full service brake application.

The apparatus on the locomotive consisted of the usual gages which indicated main reservoir, brake pipe, and brake cylinder pressure, and in addition a brake cylinder indicator was used on the tender brake cylinder and served to measure the pressure in all of the brake cylinders of the locomotive and tender, viz., one engine truck, two driver brakes, one trailer truck and one tender brake cylinder. A voltmeter, calibrated in m.p.h. was connected to a generator, belt-driven from the right front engine truck wheel, and served as a guide to the engineman in obtaining the desired speed.

A device for recording automatically the distance traveled by the train beyond the point of brake application was driven from the left engine truck wheel and was used in connection with the wheel sliding indicators on the cars.

Devices similar to those used in former brake tests were employed to operate the track circuit breakers and to automatically apply the brakes at the zero circuit breaker.

On the locomotive, observations were taken of the time of stop and the main reservoir and brake pipe pressure, the tender piston travel and the amount of coal and water on the tender.

Each car was furnished with a brake cylinder indicator and a wheel sliding indicator, with the necessary wiring and connections.

A chronograph, recording the distance of stop, time of stop, deceleration of train, the brake cylinder pressure and the brake pipe pressure, was located on car six. In connection with this chronograph a record was made of the action of the brake shoes with respect to sparking.

Indicators for measuring the slack action between the cars were used at different points in the train.

Specially designed apparatus was used to measure the pressure delivered to the brake shoes during some of the tests the object of which was to determine the efficiency of the brake rigging.

Telephones were located in the first, third, sixth, ninth and twelfth cars and greatly facilitated the issuing of instructions.

The tests were made on the south bound track of the Atlantic City division of the W. J. & S. R. R. The portion of the track over which the braking was done was level, and part of a tangent about 25 miles long terminating at Absecon Station. A slight descending (0.3 per cent) grade approaching the measured test track was in favor of the train attaining speed. The point at which the brakes were applied was 2880 ft. north of mile post 9.

The track for a distance of 5000 ft. south of the zero point was wired for circuit breakers, which were placed at intervals of 25 ft. up to 1200 ft. from the zero point, and at intervals of 50 ft. from there on to the 5000 ft. point. Preceding the zero point, eight circuit breakers were located, 66 ft. apart from which the initial speed of train (speed at the trip) was determined.

A cabin, located near the zero circuit breaker, contained the clock and chronograph from which in connection with the track circuit breakers, the speed of the train before and during the stop was obtained.

After each test measurements were taken of the total length of the stop, and also the running piston travel on each car.

Of the devices used on the track, the only one which requires special mention is the rail friction machine. This machine measured the force required to move or keep moving a block of tire steel resting upon the rail. The pressure of this block on the rail could be varied by means of weights of 20, 40, 60, 80 and 100 lb. Readings were taken with each of these weights and the coefficient of rail friction recorded was derived from the average of the five readings.

When making a test run the engineman endeavored to reach a speed slightly above that desired, just before entering the measured track. The throttle was closed just before reaching the circuit breakers preceding the zero point, no change being made in the position of the reverse lever. The train then drifted over the circuit breakers preceding the zero point

at which point the brake was automatically applied by the trip mechanism. At the instant the brake pipe exhaust started at the trip, the brake valve handle was moved to emergency position for all emergency tests and to lap position for all service application stops. When the engine and cars were to be stopped separately (breakaway tests), the same procedure as above was followed, except that the coupling pin between the engine and tender was pulled out as soon as possible after steam was shut off. This permitted the engine to pull away from the train as soon as the brake application was made, providing the retardation of the cars was higher than that of the locomotive.

However, the engine did not always separate from the train when making stops with low breaking powers on the cars. On this account it was decided to use steam on the locomotive in such tests as soon as the coupling pin was pulled out, so as to get the locomotive away from the cars and permit the cars to stop without any possible interference on the part of the locomotive, the stop of the locomotive in such cases being disregarded. For such stops the flexible wiper and the tripping mechanism were on the first car instead of the locomotive.

In all 691 tests were made, at Absecon, covering a period of time from February 10 to May 22, 1913. The average day's work consisted in making from 10 to 12 runs. A maximum of 22 tests were made in one day.

CONCLUSIONS.

In service applications with the improved (UC) equipment a greater flexibility of operation is provided. That is, the braking power per pound of brake pipe reduction is lower, thus giving the engineer a greater time in which to use judgment when manipulating the brakes. At the same time, however, the maximum braking power obtainable in a full service application is higher.

A more sensitive and prompt release of the brakes is insured, tending to improve the releasing action of all brakes in the same train of mixed old and new equipments.

The action of the old and the new equipments mixed in the same train is harmonious and free from rough slack action or shocks both in service and emergency operation.

The UC equipment is adaptable to any weight of car and may be installed to furnish any desired nominal per cent of braking power.

With the new equipment operating electrically or pneumatically, there is always available a quick acting and fully effective emergency brake. This is not the case with the old equipment, in which the relation of the service and emergency functions is such that a quick action application could not be obtained after a service application of any consequence. The following average results indicate the degree to which this difference has an effect on the length of stop. Considering the ordinary full service stop from 60 miles per hour with both brakes (say 2000 or 2200 ft.) as 100%, the attempt to make an emergency application with the old equipment does not produce any shorter stop than if only a full service application were made. With the improved apparatus operating pneumatically, an emergency application following a partial service application will shorten the stop about 14% and after a full service application about 10%.

With the electro-pneumatic brake these figures are respectively 23% and 15%.

An electrically controlled brake application has been recognized as ideal ever since the report to this effect presented by the Master Car Builders' Committee in charge of the famous Burlington Freight Brake Trials 1886 and 1887, for the reason that thereby the time element in starting the application of the brakes on various cars in the train is eliminated, a correspondingly shorter stop made, and the possibility of shocks at any speeds removed. With the new brake apparatus the effectiveness of the pneumatic emergency application is so considerably increased that the saving in time due to electric control has proportionately less influence on the length of stop, but its effect in eliminating serial action and consequently the possibility of shocks due to brake application is of correspondingly greater importance.

The graduated release feature of the improved brake apparatus permits stops to be made shorter, smoother and with a greater economy in time and compressed air consumption.

The new apparatus can be applied to give only the equivalent of the old standard apparatus if desired but in such a form the complete new apparatus can then be built up by the addition of unit portions to the simplest form of the mechanism.

The electro-pneumatic brake acts as an automatic telltale in cases of malicious or accidental closing of an angle cock after the train is charged by permitting all the brakes to apply, it being thereafter impossible to release the brakes behind the closed cock until the cock is opened.

The PM equipment will start to apply on a brake pipe reduction of 2 lb. A 4-lb. brake pipe reduction is required to start an application with the UC equipment, thereby preventing undue sensitiveness to application on slight, unavoidable fluctuations in brake pipe pressure. As a bona fide service reduction of more than 4 lb. continues, the rate of attainment of braking power is the same as if no stability feature had existed.

The attainment of full service braking power on the entire train with the UC equipment operating pneumatically was 16 seconds, 33% longer than with the PM equipment because of the smaller size reservoirs used for greater flexibility.

Full service braking power was obtained in nine seconds with the electro-pneumatic brake but without sacrificing desirable flexibility because of the increased sensitiveness of control when operating the brakes electrically.

The time of transmission of serial quick action through the brake pipe is practically the same with UC and PM equipments.

The time to obtain full emergency braking power with the PM equipment on the entire train was 8 seconds; with the UC equipment operating pneumatically 3.5 seconds or 56% shorter; with the electro-pneumatic equipment 2.25 seconds or 72% shorter.

The gain in emergency stopping power of the electric pneumatic equipment over the PM equipment results from: (a) the shorter time occupied in applying the brakes; (b) a higher brake cylinder pressure obtained; (c) the holding of the pressure as obtained, without blow-down, as with the high-speed reducing valve of the PM equipment.

Designating the time of equivalent instantaneous application of retarding force by t, and the braking power, corresponding to the brake cylinder pressure obtained, by P, the values of t for emergency applications with the PM equipment 12 car train range from 2 to 2.5 seconds, for the UC pneumatic from 2 to 2.5 and for the electro-pneumatic from 0.7 to .85 seconds.

The observed average value of P, with the PM equipment (for a nominal 113% braking power on the cars) ranges from 95% to 100%. With the UC pneumatic equipment and electro-pneumatic equipment nominal emergency braking powers of 90, 125, 150 and 180% were used, which, due to locomotive effect, become for the complete train 90%, 117%, 137% and 160% respectively.

With the electro-pneumatic brake a uniform increase in per cent of braking power results in a substantially uniform decrease in length of train stop. An increase of 5% in braking power reduces the length of stop about 2% within the range of braking powers tested.

The available rail adhesion varies through the wide limits, e.g., from 15% in the case of a frosty rail early in the morning to 30% for a clean, dry rail at mid-day.

The amount of wheel sliding depends more on the rail and weather conditions than on the per cent braking power. Some sliding was experienced with braking powers as low as 90% and 113% where rail conditions were unfavorable, but 180%

braking power did not cause wheel sliding with good rail conditions.

The effect of excessive wheel sliding was to make the length of the stop about 12% greater than similar stops without wheel sliding.

A braking power low enough to eliminate the possibility of wheel sliding on a bad rail results in longer stops than could be considered satisfactory for general service. Since good rail conditions prevail a large part of the time, the preferable emergency graking power is that which, considering the installation conditions, will stop trains at all times in as short a distance as can be accomplished without trouble from wheel sliding in such cases as are to be anticipated when emergency stops have to be made under unfavorable rail conditions. Advantage might be taken of this fact to use a higher braking power in summer than could be used in the winter with the same degree of freedom from objectionable wheel sliding.

The amount of wheel flattening when sliding occurs depends upon the weight upon the wheels, the materials in the wheels and rails, and the condition of the rail surface. The rail surface may be such that relatively long slides will produce but small flat spots, or, conversely short slides may produce flat spots of a size requiring prompt attention.

When the UC equipment is used on the cars an arrangement giving a high emergency braking power on the locomotive, with a blow-down feature, has advantages as follows:

(a) Shocks between locomotive and cars practically eliminated.
(b) Shorter stops
(c) No more wheel sliding than to be expected with the present installation of ET equipment.

An efficient design of brake rigging must be produced before the advantages of improved air brakes or brake shoes can be fully utilized.

The use of the clasp type of brake rigging eliminates unbalanced braking forces on the wheels and so avoids the undesirable and troublesome journal and truck reactions that come from the use of heavy braking pressures on but one side of the wheel. This has an important effect not only on freedom from journal troubles but also in enabling the wheel to follow freely vertical inequalities of the track.

The clasp brake also improves the brake shoe condition materially, both as to wear and variability of performance.

Although the clasp brake rigging will produce better stops than a single shoe brake rigging equally well designed (other conditions being equal), its advantage in this direction is of less importance than in the improved truck, journal and shoe conditions mentioned above.

The tests indicated that at least 85% transmission efficiency could be obtained with either single shoe or clasp brake rigging.

The following features were observed to be of importance if maximum overall brake rigging efficiency is to be secured:

(a) Protection against accidents that may result from parts of rigging dropping on the track.

(b) Maximum efficiency of brake rigging at all times to insure the desired stopping with a minimum per cent of braking power.

(c) Uniform distribution of brake force, in relation to weight braked, on all wheels.

(d) With a given nominal per cent braking power, the actual braking power to remain constant throughout the life of the brake shoes and wheels.

(e) Piston travel to be as near constant as practicable under all conditions of cylinder pressure.

(f) Minimum expense of maintenance and running repairs of brake rigging between the stopping of cars.

The brake shoe bearing was the most difficult factor to control and at the same time the most potent in producing variations in brake performance.

The tests established the possibility of a variation of 15% to 20% in length of stops from 60 m.p.h. with all factors except brake shoe condition remaining substantially constant. Continued stopping with moderate braking pressures produced a constantly improving brake shoe condition and shorter stops. This is evidence that with reasonable attention to brake shoe maintenance the condition of the shoes on cars in ordinary road service is likely to be more favorable to making short emergency stops than during a series of tests in which the brake shoes are worked severely.

The difference in the efficiency of the clasp and single shoe rigging may offset the gain which might be expected from difference in coefficient of friction and vice versa. Consequently as neither of these factors could be observed uninfluenced by the other, a satisfactory comparison of the mean coefficient of friction under different rigging conditions or of different types of rigging or air brake apparatus under variable shoe conditions in road tests, is impossible.

High braking powers from high initial speeds result in a great heating of the working surface of the shoe and a rapid abrasion. This effect is most marked under severe braking conditions such as obtained when heavy cars equipped with one brake shoe per wheel are stopped.

Shoes of the same type and hardness had a high rate of wear per unit of energy absorbed when a low coefficient of friction was developed, and, conversely, a lower rate of wear when a higher coefficient of friction was developed.

Both the road and the laboratory tests confirmed previous tests and conclusions from analysis that the temperature of the working metal is the determining influence in coefficient of brake shoe friction. The other factors that may be involved become effective chiefly as they affect the change of temperature of the working metal.

The general performance of the shoes as observed during the road tests formed the basis of the program established for laboratory tests, which resulted in the following deductions:

a The generation of the retarding forces and consequent absorption of the energy of the moving train is dependent upon but a very small quantity of brake shoe metal.

b The actual bearing area rather than the total face area of the shoe is the important factor in brake shoe performance.

c The magnitude of the bearing area changes throughout the stop and is greatest near the end of the stop.

d The bearing area shifts continuously from one portion of the surface to another during the stop.

e The principal factor in producing high friction for any given braking condition is the frequent shifting of the bearing area from the heated to the cooler spots over the face of the shoe.

f Slotted shoes or shoes that are cracked are more flexible than solid shoes and the bearing area shifts more readily than in the case of solid shoes.

g With shoes of the same type and approximately the same hardness, the wear per unit of work done is less with the slotted shoe than with the solid shoe. The stops with slotted shoes were always shorter and the mean coefficient of friction higher than with solid shoes.

h The shifting of the bearing area will tend to be more rapid if the size provides more available area for shoe bearing.

i The greater the pressure per square inch of bearing area, the lower will be the mean coefficient of friction.

j Flanged shoes provide more available area for bearing than unflanged shoes.

k The use of two shoes instead of one per wheel will result in a higher coefficient of friction and less wear per unit of work done.

l A comparison of the values of mean coefficient of friction for standard and for clasp brake conditions indicates a decided advantage for the clasp brake throughout the entire range of braking powers. The gain in favor of the clasp brake with slotted shoes amounts to about 40%, at a braking power of

180%, and 100%, at a braking power of 40%, an average gain for the whole range of braking powers of about 70%.

m From a brake shoe standpoint the advantage of using two shoes instead of one shoe per wheel may be summed up as follows:—

First. The clasp brake shoe is associated with but one-half the wheel load and consequently has but one-half as much energy to absorb.

Second: The clasp brake shoe is working at only one-half the shoe pressure at which the standard shoe must work under the same braking power.

Third: The available work area for the same amount of energy to be absorbed is double.

A possible source of disadvantage when using two shoes per wheel is that a warped or poorly bearing shoe is subjected to less pressure tending to force it into a good contact with the wheel. For this reason though the available shoe area is doubled when using clasp brakes the actual amount of working metal throughout the stop may be less than with a single shoe, which is less capable of resisting the tendency of the heavier pressure to cause a better fit of shoe to wheel.

This, and an especially good shoe condition due to previous moderate pressure tests in each case, is an explanation why three of the 60 m.p.h. 150% B.P. electro-pneumatic stops with the single shoe train were shorter by 50 ft. than the best stops of either of the first or second clasp brake trains.

On the other hand the disadvantage and greater variability of the single shoe brake is evidenced in the fact that under the same conditions as cited above two stops with this train were longer than the longest stops without material wheel sliding made with either of the two clasp brake trains.

With plain solid shoes the durability will be increased 41.1% under clasp brake conditions as compared with that under single shoe conditions.

With plain slotted shoes the durability will be increased 33.5% under clasp brake conditions as compared with that under single shoe conditions.

The superior durability of the plain slotted shoe as compared with the plain solid amounts to 11.7% under single shoe brake conditions and 5.9% under clasp brake conditions.

The wear of the flanged solid shoes per unit of work done is 19% less than for plain solid shoes, and for flanged slotted 26% less than for plain slotted shoes, or 30% less than plain solid shoes.

The wear of plain slotted shoes per unit of work done is 5.4% less than the wear of plain solid shoes, and the wear of the flanged slotted is 13.2% less than the wear of flanged solid shoes.

For the same amount of work done flanged solid cost 16% less than plain solid shoes, and flanged slotted cost 23% less than plain slotted, or 27% less than plain solid shoes.

Approximately 135% more stops will be required to wear out the flanged solid than will be required to wear out the plain solid shoe; 158% more stops to wear out the flanged slotted than the plain slotted shoe, and 171% more stops to wear out the flanged slotted than the plain solid shoe.

For any given braking condition with cast-iron brake shoes the indications are that the best relation will exist between shoe wear and mean coefficient of friction when the Brinell hardness of the cast iron is about 190.

Machine and road tests show a difference in stopping distance for the same type of shoe under the same braking conditions.

The effect of the difference in wheel surface conditions is one of the leading factors which go to make up the difference between machine and road tests. The difference in braking performance can be established and the factor expressing this difference be applied to laboratory results to predict the performance of a car or train.

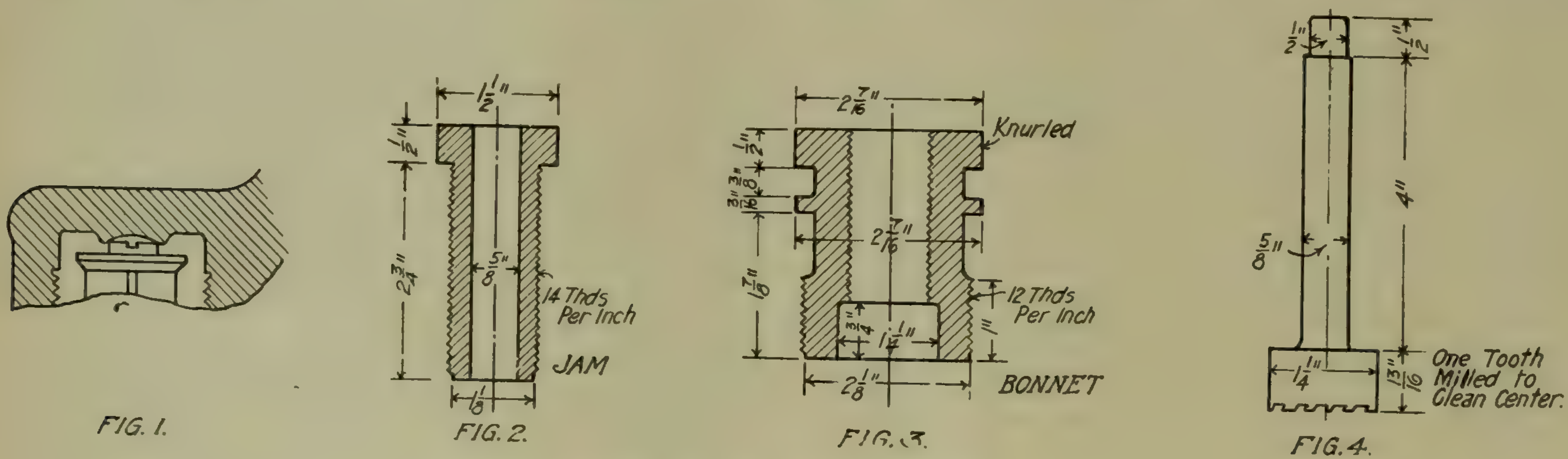
The stops and observed performance of the air brake, brake rigging and brake shoe are in agreement with the relation generally assumed to exist between the speed and other variables mentioned and resultant length of stop.

REAMER FOR TRUING UP AIR PUMP STOP BOSSES.

By F. W. Bentley, Jr.

The faces of stop bosses regulating the lift of the lower discharge and receiving valves of the Westinghouse 9½" pump are in a short time hollowed by the action of the valve. It is not an uncommon occurrence to discover an air cylinder on which these bosses have been pounded or worn in to a depth of $\frac{1}{8}$ of an inch.

The insertion of a new valve consequently possessing a perfectly true boss face necessitates the truing up of the stop face in the pump. The rounding or curved nature of the hollow renders it impossible for the valve lift to be perfect otherwise, as the result would be as shown in Fig. 1, unless the rim of the valve's boss were rounded off, and this is neither expedient nor workmanlike.



Reamer for Air Pump Stop Bosses.

The accompanying sketch is descriptive of a simple reamer for use in truing up the faces of the stop bosses, which are a part of the air cylinder casting. Its use leaves a perfectly flat face and makes it possible to secure an accurate and correct lift of the air valves, which it is needless to say is one of the most important points in the repair of the pump.

TO DO PROPER WORK a man must have perfect control of the tools with which that work is to be done—and in this connection the word tools is used in its very broadest sense. But no man can properly control tools until he has learned to control himself. Think what would happen if a railway man lost his head—lost control of himself—in an emergency. Self-control is a habit. Any habit can be acquired. This is one habit that will be of value. Cultivate it.—*Brill Magazine.*

Pacific and Mountain Locomotives, C. R. I. & P. Ry.

Recent developments in railroad transportation have demonstrated that the most efficient way to handle heavy traffic is with powerful locomotives and large train loads. Powerful operating units, having demonstrated their ability to reduce operating costs in freight service, have attracted the attention of motive power officials to their heavy passenger service.

Remarkable reductions in operating costs have been acquired by the Rock Island Lines by the adoption of heavy Mikado locomotives. This policy was the direct cause of putting into passenger service, thirty large and powerful Pacific type locomotives and two of the heaviest Mountain type locomotives ever built, which have recently been delivered to the Rock Island Lines by the American Locomotive Company.

The Pacific type engines are operating at present between the following points:

Rock Island, Ill., to Valley Jct., Ia.—Maximum grade per mile 58 ft.

Valley Jct., Ia., to Council Bluffs, Ia.—Maximum grade per mile 69 ft.

Phillipsburg, Kan., to Goodland, Kan.—Maximum grade per mile 53 ft.

Goodland, Kan., to Limon, Colo.—Maximum grade per mile 53 ft.

Rock Island, Ill., to Trenton, Mo.—Maximum grade per mile 79 ft.

Herington to Liberal, Kan.—Maximum grade per mile 42 ft. Liberal, Kan., to Tucumcari, N. M.—Maximum grade per mile 53 ft.

From Phillipsburgh, Kan., to Limon, Colo., is a constant up-hill pull 247 miles long. The ruling grades are 53 feet to the mile.

Several test trains were run to determine the capacity of these Pacific type locomotives. The following tables show the results as compared with the carded time of several trains:

IOWA DIVISION. WESTBOUND AND EASTBOUND

Between Davenport and Valley Junction, Ia.
Distance, 178.9 miles. Maximum grade, 58 ft. per mile

	Carded Time			Actual Tests		
	Train No. 5 Westbound	Train No. 7 Westbound	Train No. 8 Eastbound	Test No. 1 Westbound	Test No. 2 Westbound	Test No. 3 Westbound
Act. running time, hrs. & min.	5:16	4:34	4:47	4:47	5:07	4:49
Number of stops	10	4	4	4	12	8
Avg. schedule speed, M.P.H.	31.7	37.3	35.4	32.1	29.2	31.7
Avg. running speed, M.P.H.	34.2	39.3	37.8	37.6	35.2	37.3
Number of cars	11	8	8	12	13	13
Avg. Wt. of car in tons	62.0	65.6	63.5	75.0	58.0	63.3
Train tonnage (Exclusive of lading)	682	525	508	900	755	827

Between Valley Junction, Ia., and Council Bluffs, Ia.
Distance, 136.6 miles. Maximum grade, 69 ft. per mile

	Carded Time			Actual Tests			
	Train No. 5 Westbound	Train No. 7 Westbound	Train No. 8 Eastbound	Test No. 4 Westbound	Test No. 5 Westbound	Test No. 6 Eastbound	Test No. 7 Eastbound
Act. running time, hrs. & min.	3:47	3:27	3:33	3:24	3:43	3:37	3:28
Number of stops	3	1	1	3	5	3	2
Avg. schedule speed, M.P.H.	34.0	38.7	37.6	37.4	34.1	33.6	37.2
Avg. running speed, M.P.H.	36.0	39.6	38.4	40.2	36.7	37.8	39.3
Number of cars	11	8	8	12	15	13	13
Avg. Wt. of car in tons	62.0	65.6	63.5	75.0	57.5	63.3	60.0
Train tonnage (Exclusive of lading)	682	525	508	900	865	824	781

COLORADO DIVISION, WESTBOUND

Between Phillipsburg, Kan., and Goodland, Kan.
Distance, 139.9 miles. Maximum grade, 53 ft. per mile

	Carded Time			Actual Tests		
	Train No. 5	Train No. 7	Test No. 8	Test No. 9	Test No. 10	Test No. 11
Act. running time, hrs. & min.	4:04	3:09	3:40	3:42	3:54	3:52
Number of stops	2	1	2	4	7	4
Avg. schedule speed, M.P.H.	32.9	43.0	35.9	28.6	33.3	33.7
Avg. running speed, M.P.H.	34.3	44.4	38.0	37.8	35.8	36.2
Number of cars	10	8	12	14	15	15
Avg. Wt. of car in tons	62.0	65.6	75.0	53.6	56.3	58.0
Train tonnage (Exclusive of lading)	620	525	900	750	844	870

Between Goodland, Kan., and Limon, Colo.
Distance, 107.1 miles. Maximum grade, 53 ft. per mile

	Carded Time		Actual Tests			
	Train No. 5	Train No. 7	Test No. 12	Test No. 13	Test No. 14	Test No. 15
Act. running time, hrs. & min.	3:25	2:40	3:10	2:41	3:12	2:56
Number of stops	1	1	1	1	5	5
Avg. schedule speed, M.P.H.	30.5	38.9	32.4	34.8	31.0	25.5
Avg. running speed, M.P.H.	31.4	40.1	33.8	39.9	33.4	36.5
Number of cars	10	8	12	14	15	15
Avg. Wt. of car in tons	62.0	65.6	75.0	53.6	56.3	58.0
Train tonnage (Exclusive of lading)	620	525	900	750	844	870

MISSOURI DIVISION, WESTBOUND

	Davenport to Eldon, Distance 111.6 miles		Eldon to Trenton, Distance 121.5 miles	
	Carded Time Train 1	Actual Test Test 16	Carded Time Train 1	Actual Test Test 17
Act. running time, hrs. & min.	2:40	2:40	3:08	3:19
Number of stops	4	6	3	3
Avg. schedule speed, M.P.H.	38.2	38.5	36.5	34.2
Avg. running speed	41.8	41.8	38.8	36.4
Number of cars	6	14	6	14
Avg. wt. of car in tons	65.0	66.6	65.0	66.6
Train tonnage (Exclusive of lading)	390	933	390	933

No difficulty was experienced in maintaining full boiler pressure at all times. The locomotives steamed very freely and very little black smoke was emitted at the stack. The maximum cut-off was 16 inches, and the locomotives were worked there only for short distances, nearing the apex of severe hills. Except for forward hard pulls the locomotives were generally worked at 6 to 8 inch cut-off. The handling of air was satisfactory, no discomforture being experienced by passengers in rear cars of these long trains from this cause.

While no extensive tests have been conducted to determine economy on fuel and water of the new Pacifics it was the opinion of the engine crews on these heavy trains that there was no increase over the older Pacific types.

Were it not for their introduction on this line at this time it would have been necessary to either double-head or operate in two sections.

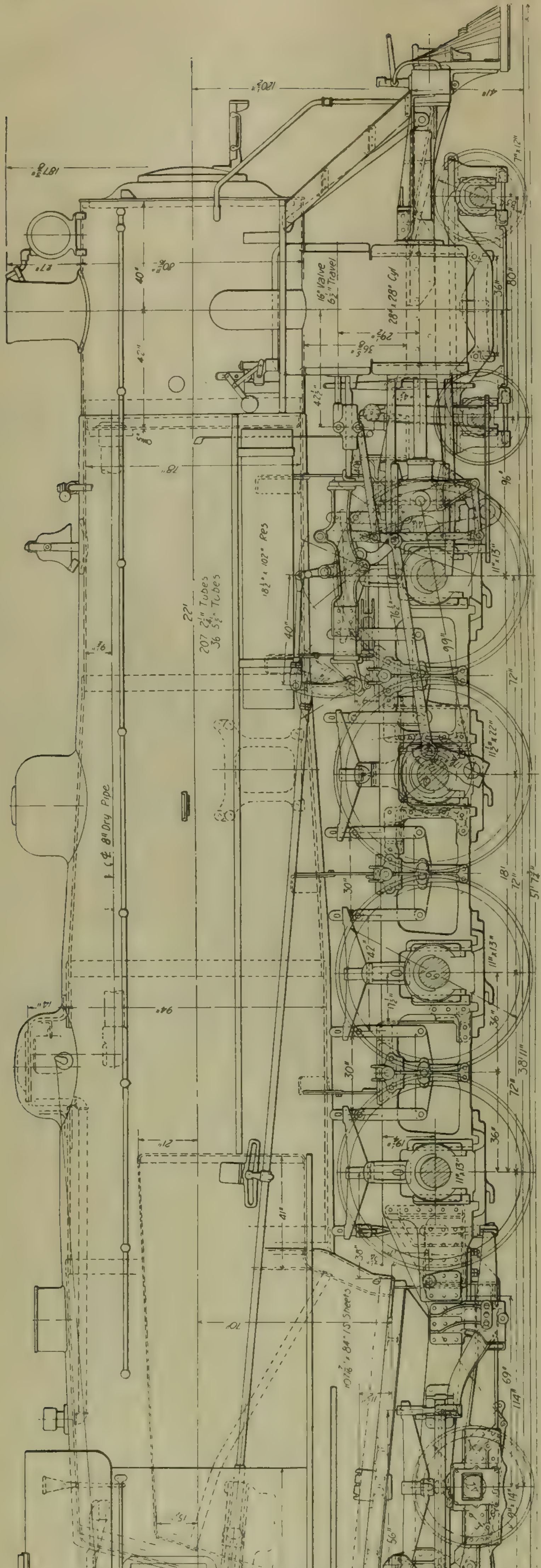
By the introduction of the Mountain type locomotives the Rock Island has been enabled to consolidate the Chicago and St. Louis sections of one of the Colorado trains between Phillipsburgh and Limon. This has effected a saving of 180,310 passenger train miles per annum.

At present these combined trains consist of 10 to 13 cars, which can be satisfactorily handled by the new Pacifics, except in extreme weather. Therefore, there has been no opportunity as yet to test the mountain type to its full capacity.

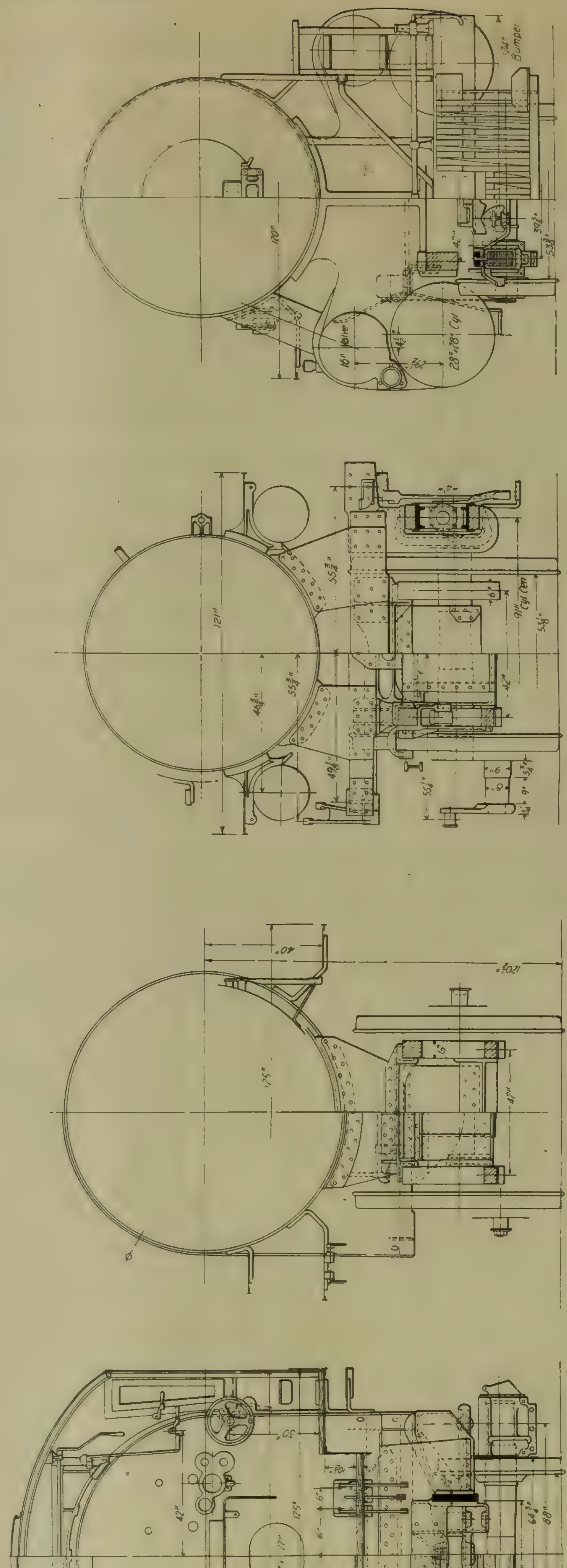
However, it is anticipated that they will handle 1,000 tons in 16 cars on the carded time of these combined trains without difficulty. The combined train, under normal conditions, will be 15 and 16 cars, largely steel equipment, which the mountain type locomotives will ably handle over the 247 mile 1 per cent grade constant up-hill pull westbound from Phillipsburgh to Limon. Westbound this combined train has 9 scheduled stops and 20 flag stops between these two points, which make the Mountain type more efficient than the new Pacific type on account of their greater starting effort.

In general construction the designs embody the latest approved practice and follow the standards of the builders. Each design is equipped with a super heater, brick arch, screw reverse gear, extended piston rods, long main driving boxes, Woodard engine truck, speed recorder, Baker valve gear, Chambers throttle, the Mudge-Slater smokebox arrangement and vanadium cast-steel frames. The Mountain type is also equipped with the Foulder main rod, and engine and tender were arranged so that the Street stoker could be applied later if desired.

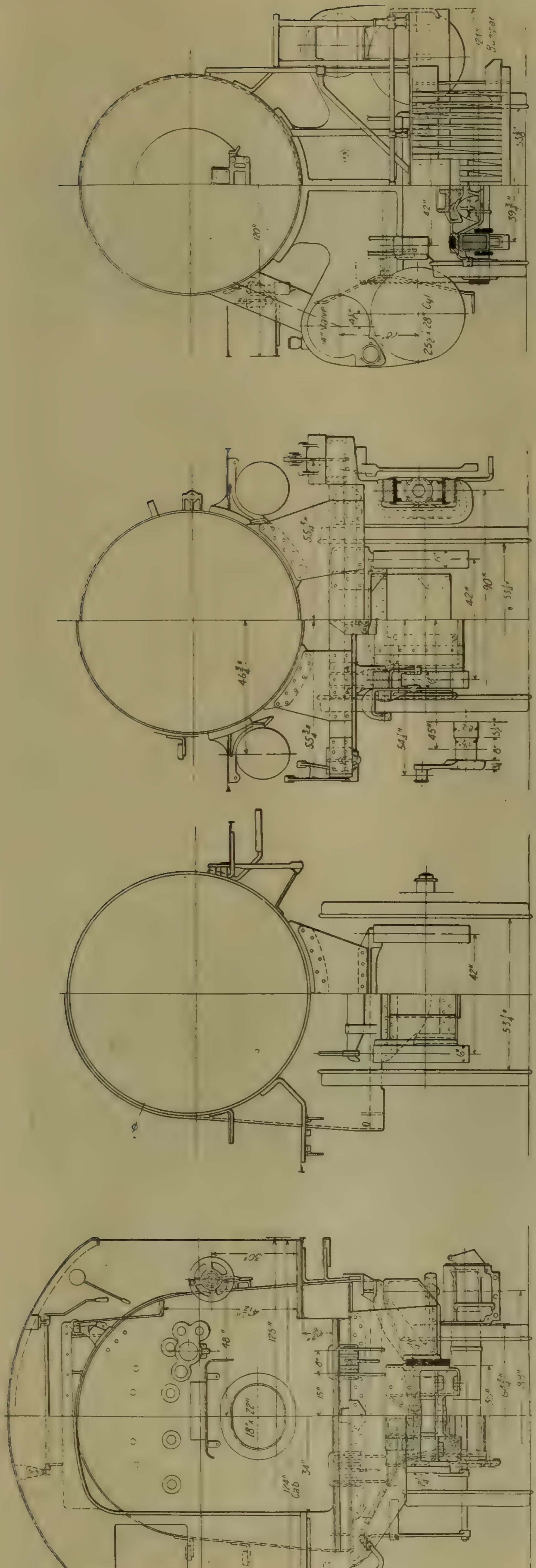
These designs are the product of the long experience of the American Locomotive Company in the development of powerful locomotives. The application of this experience to the railroad's specific requirements was directed by the officials



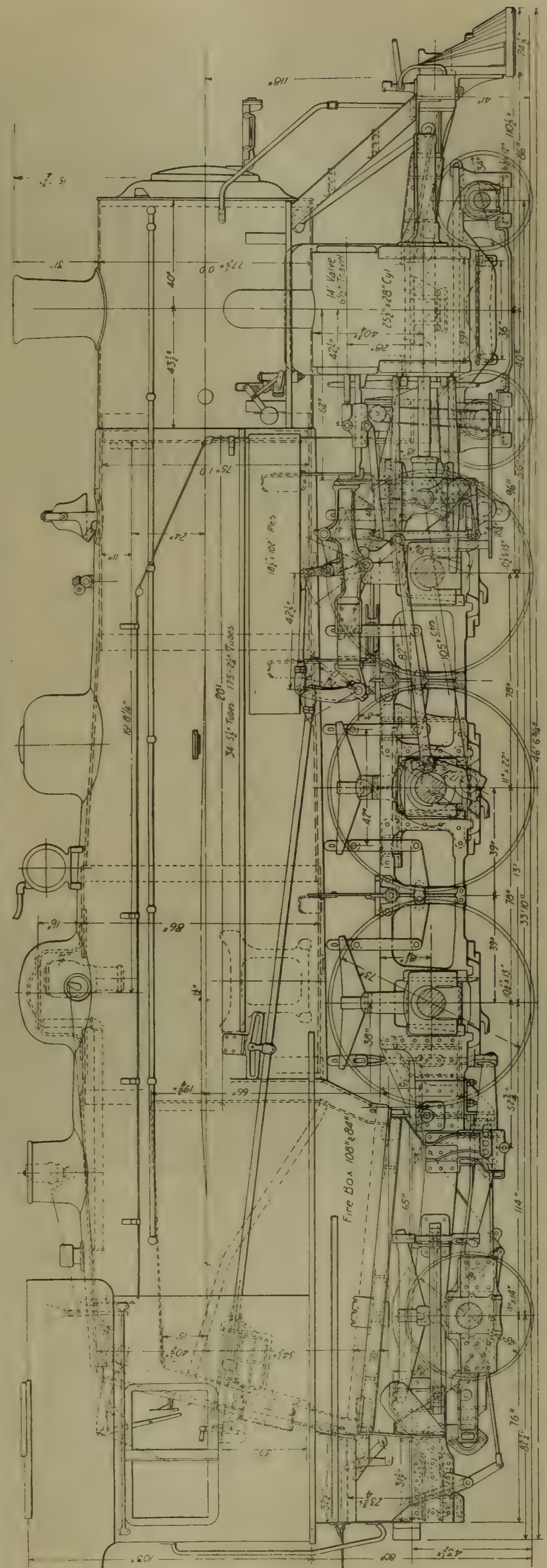
Elevation of Mountain Type Locomotive, C., R. I. & P. Ry.



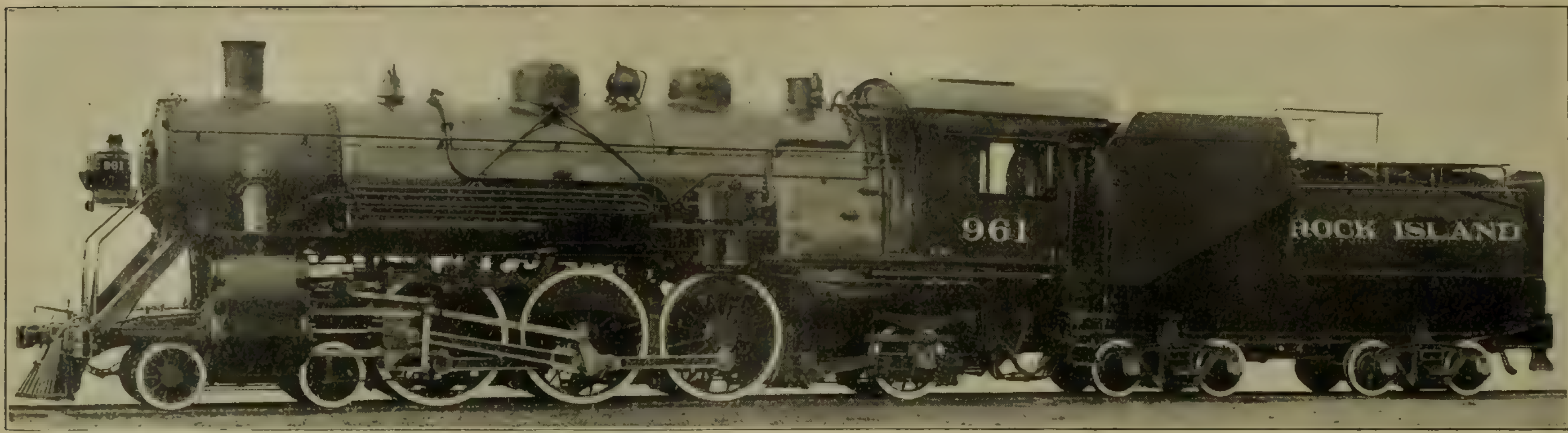
Sections of Mountain Type Locomotive, C., R. I. & P. Ry.



Sections of Pacific Type Locomotive, C., R. I. & P. Ry.



Elevation of Pacific Type Locomotive, C., R. I. & P. Ry.



Pacific Type Locomotive for the Rock Island.

of the motive power department, to whose valuable co-operation in the preparation of the designs the success of the locomotives is largely due. They furnish another striking example of reduced operating costs which have been obtained by combining fuel saving devices and improved designing in a larger and more powerful operating unit.

The tables contain the principal dimensions of these two types of locomotives:

	Pacific	Mountain
Gauge	4'-8½"	4'-8½"
Cylinders	25½"x28"	28"x28"
Valves	Piston, 14" diam.	Piston, 16" diam.
Tractive power	40260 lbs.	50000 lbs.
Factor of adhesion	4.34	4.50
Boiler—		
Type	Extended Wagon-top	Wagon-top
Diameter	76⅜"	78"
Working pressure	190 lbs.	185 lbs.
Fuel	Soft coal	Soft coal
Staying	Radial	Radial
Number	5½", 34; 2¼", 195	5½", 36; 2¼", 207
Length	20'-0"	22'-0"
Heating Surface—		
Fire box	212.8 sq. ft.	287 sq. ft.
Tubes & Flues	3259.4 sq. ft.	3805 sq. ft.
Arch tubes	25.4 sq. ft.	25 sq. ft.
Total	3497.6 sq. ft.	4117 sq. ft.
Superheating surface	805 sq. ft.	944 sq. ft.
Grate area	63.0 sq. ft.	62.7 sq. ft.
Driving Wheels—		
Diameter, outside	73"	69"
Diameter, center	66"	62"
Journals, main	11"x22"	11½"x22"
Journals, other	10½"x13"	11"x13"
Wheel Base—		
Driving	13'-0"	18'-0"
Rigid	13'-0"	18'-0"
Total engine	33'-10"	38'-11"
Total engine & tender	65'-1¼"	70'-2¼"
Weight—		
In working order	281,500 lbs.	333,000 lbs.

Mountain Type Locomotive for the Rock Island.

Fire Box—			
Length	108"		108"
Width	84"		84"
Thickness of sheets, sides	⅜"	sides	⅜"
Thickness of sheets, back	⅜"	back	⅜"
Thickness of sheets, crown	⅜"	crown	⅜"
Thickness of sheets, tube	⅝"	tube	⅝"
Water Space—			
Front	6"		6"
Sides	5"		5"
Back	5"		5"
Tubes—			
Material	Seamless steel		Seamless steel
Diameter	5½" & 2¼"		5½" & 2¼"
Thickness	5½", 0.150"		5½", 0.150"
	2¼", 0.135"		2¼", 0.135"

On driving wheels	174,500 lbs.	224,000 lbs.
On trailers	54,000 lbs.	51,500 lbs.
On engine truck	53,000 lbs.	57,500 lbs.
Total engine & tender	440,300 lbs.	490,500 lbs.
Tender—		
Wheels, number	8	8
Wheels, diameter	34"	33"
Journals	6"x11"	6"x11"
Tank capacity	8,500 gals.	8,500 gals.
Fuel capacity	14 tons	14 tons

THE LOCOMOTIVE PUBLISHING CO., 3 Amen Corner, London E. C., England, has published a souvenir containing twelve illustrations of locomotives used on various Canadian railways. The illustrations are of large size and on high grade paper, the whole booklet making a very pleasing appearance.

STRUCTURAL STEEL TRUCKS, CANADIAN PACIFIC RY.

By R. W. Burnett, G. M. C. B., Canadian Pacific Ry.

On account of the faults common to all composite passenger trucks which cause unsatisfactory service and expense in maintenance, a design of a structural steel truck was prepared by the Canadian Pacific Railway about three years ago, with a view of overcoming these defects.

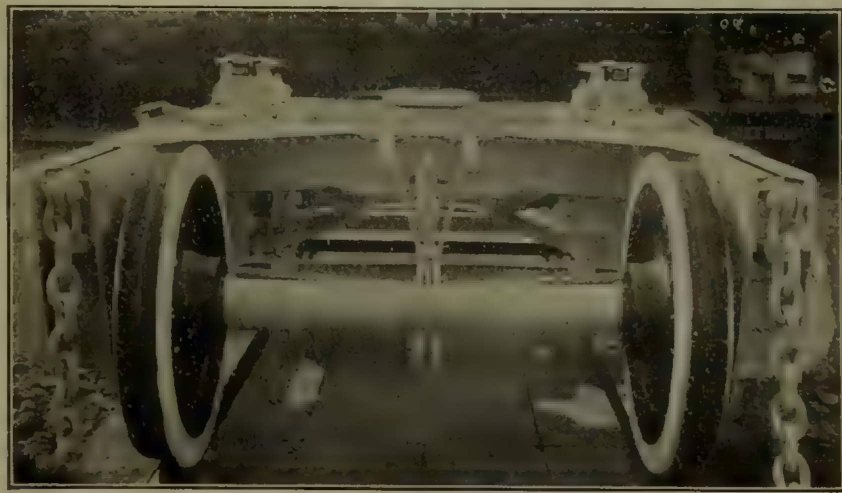
All-metal trucks of cast steel construction have been used quite extensively during the past few years and have proven quite satisfactory. The first cost of the cast steel truck is considerably in excess of the composite trucks used heretofore. The structural steel truck is considered equal to the cast steel and is somewhat cheaper in the first cost and is also much easier and cheaper to repair, as in case of any breakage, due to accident or unusual conditions, it is only necessary to replace the damaged part, whereas with the cast steel truck, in cases of breakage it is necessary to replace the entire truck frame.

In all attempts at designing a truck in the past, the side sill has been kept above the equalizer, while it has been necessary to keep the transoms down to clear center sills, draft rigging, brake gear, etc., making the use of an offset connection between transoms and side sill necessary. On this truck, the side sills are made of two channels with flanges together, the flanges being cut away to let the equalizers come up inside of the housing thus formed. The cutting away of the flanges is compensated for by the extension of the wing on the pedestal plate. The housing of the equalizer inside of the side sill makes it possible to drop the side sill so that it is flush with the transoms, doing away with the offset connection which has been used heretofore, and permitting the use of flat gusset plates above and below side sills and transoms, greatly increasing the strength and giving more room for inspection.

The principal trouble with the composite trucks is the many parts bolted together requiring constant attention, the frequent renewal of wooden parts that is necessary, and the wear of the different members.

A composite truck made new, of the strongest design, will warp before being placed in service, so that the pedestals are not plumb on the boxes, and after a year's service the pedestals are spread all distances up to 2 inches. This built-up truck is made perfectly square and plumb and remains so. It has been noted that it requires less than one-half the power to move this truck than is required to move a composite truck on account of the composite truck getting out of square.

On this truck it has been found that there is strength to spare without end sills, which also allows the side sills to be made shorter, which gives better clearance at the steps and makes inspection of trucks, platforms, and draft gear easier. This strength is secured by the strength of the side sill and the clever arrangement of gusset plates. The brakes are inside



Four Wheel, Structural Steel Truck, C. P. R.

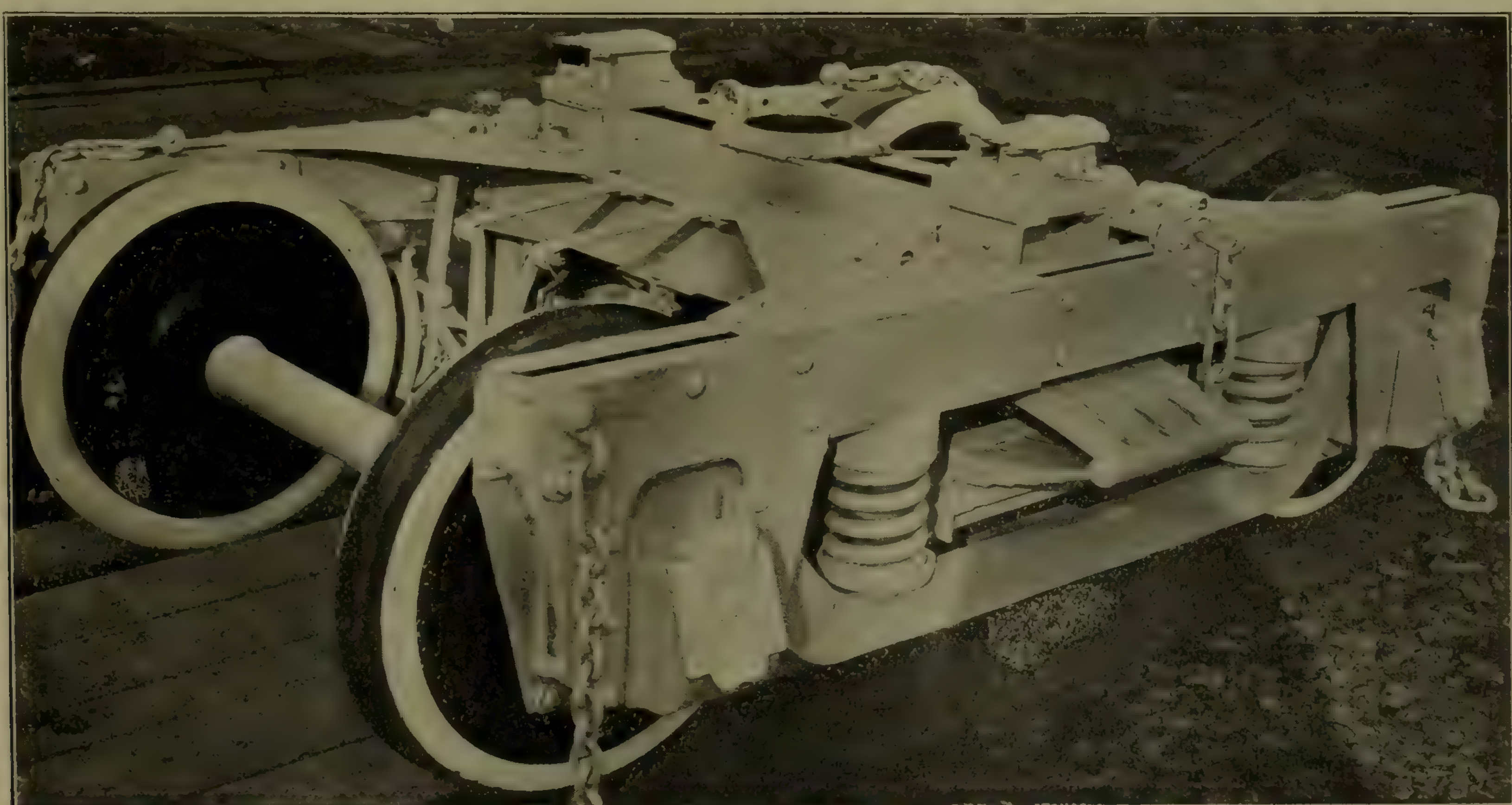
hung instead of outside hung, as with the ordinary six wheel truck it gives a more effective brake, also greatly reduces the tendency to tilt and surge, and leaves the ends free for inspection and free for any axle lighting system.

The frequent breakage and rapid wear of cast iron pedestals is an old story. Experience with cast steel pedestals has shown that they not only wear out rapidly, but soon cut through the sides of the journal boxes.

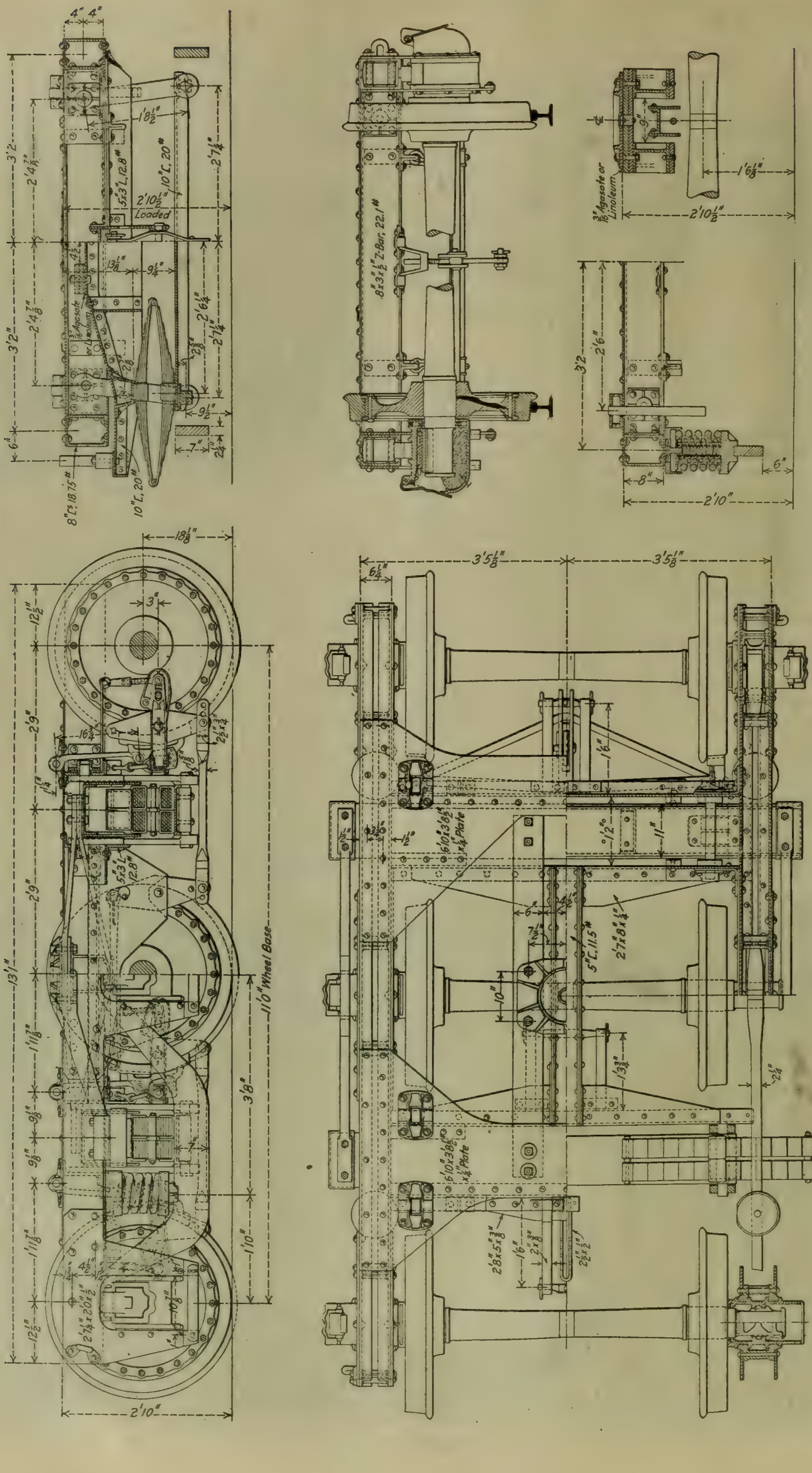
The built-up pedestal on this truck has a chilled iron filler rivetted between the two plates. Experience has shown that in two years there is no appreciable wear and that the journal boxes are not injured.

The cast iron pedestals do not add strength to the truck but the plate pedestal can be extended to act as a reinforcement, giving increased strength with reduction of weight.

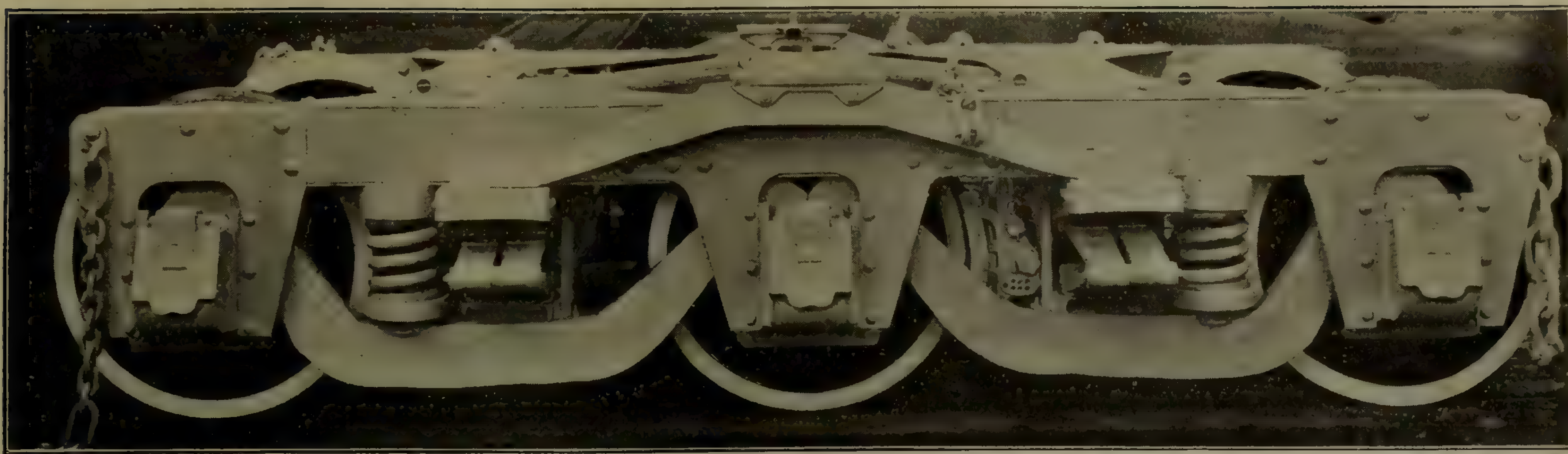
It was thought, when these pedestals were designed, that as a matter of course they would bend in case of wreck, but in wrecks that would have broken cast iron pedestals, these ped-



Four Wheel, Structural Steel Truck, C. P. R.



Plan, Elevation and Details of Six Wheel Passenger Truck, Canadian Pacific Ry.



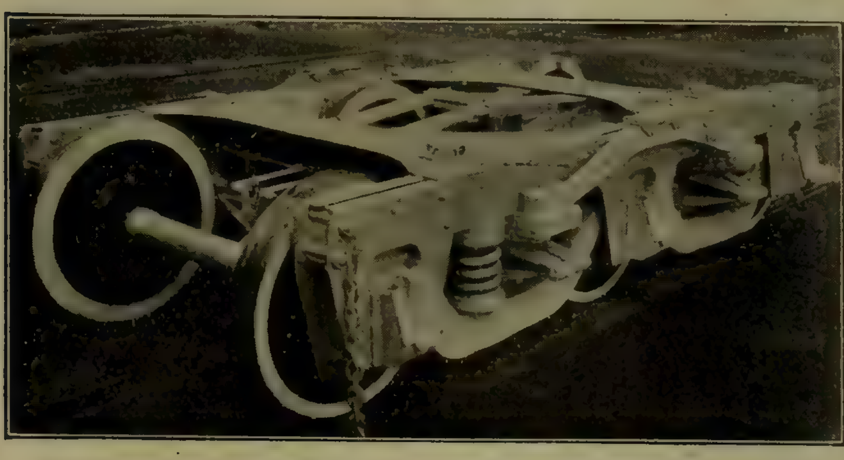
Six Wheel, Structural Steel Passenger Truck, Canadian Pacific Ry.

estals have always brought the car home. In manufacturing, these pedestals are punched out, leaving about $\frac{3}{16}''$ inside of the jaw to be milled out. About twenty are milled at one time. They are drilled on a jig and are perfectly interchangeable.

The time honored pedestal strap, which required so much attention in inspection and repairs and caused so much annoyance when changing wheels, is not needed on these trucks on account of the strength of the side sill and pedestal. A small bar is pivoted on one arm of the back member of the pedestal and fastened to the other arm by a key bolt applied to prevent the box leaving pedestal if truck is jacked up or car is derailed. The brake rigging being on top of the axles, there are no nuts and only two cotters to remove to change any pair of wheels.

Instead of the short jointed truck hangers ordinarily used, long hangers are used, the hangers on the four wheel truck being pivoted on top of the gusset plate while on the six wheel truck they are pivoted under the gusset plate.

The truck hangers and brake hanger pivots are bars of rolled steel cut to length without a head which avoids heat treatment. They are carried in a casting, one end of which is open. A cotter is placed through the casting in front of the pin while the other end of the casting has a small hole for the insertion of a drift to remove the pin. The long truck hanger is cheaper to manufacture, easier to inspect and gives an easier riding truck.



Six Wheel, Structural Steel Passenger Truck, C. P. R.

It will be noted that the brake beam release springs on the truck have been done away with. It is considered that they have always been a detriment on account of it being impossible to keep them properly adjusted, the result being that the springs adjusted the strongest, pull the opposite brake beam against the wheel, doing the reverse from what they were intended. The release of the slack is taken care of by coil springs on the body.

It will be noted that these trucks are made almost entirely of rolled shapes and flat plates with practically no forging or pressing, which reduces the manufacture to almost a question of shearing, drilling, punching and riveting. These trucks are running under more than 700 cars and have been in service long enough to absolutely prove that there is no trouble from rivets and that the cost of repairs is reduced to a question of changing wheels and brake shoes, and lubrication. These trucks were designed by R. W. Burnett, general master car builder.

Some of their main points of advantage are:

Reduced weight.	End clearance.
Increased strength.	Cheapness of manufacture.
Ease of inspection.	Low cost of maintenance.

Inside hung brakes, making trucks easier riding, easier to inspect, and easier to apply any axle lighting system.

Chilled iron wearing parts of pedestal, reducing wear on both pedestals and journal box.

Wrought pedestals, being stronger in themselves and adding strength to truck sides.

Only two cotters to remove to change any pair of wheels.

INTERNATIONAL CORRESPONDENCE SCHOOLS.

All classes of railway employes are taking advantage of I. C. S. scholarships to increase their efficiency or secure promotion. Below is noted the occupations of railway employes, enrolled from June, 1913, to January, 1914, inclusive:

Firemen	827	Flagmen	8
Engineers	198	Rodmen	8
Helpers	175	Canemen	7
Apprentices	143	Engine dispatchers	6
Wipers	132	Fire builders	6
Repairers	104	Switchmen	6
Laborers	104	Timekeepers	6
Inspectors	102	Transitmen	6
Machinists	89	Yardmasters	6
Clerks	70	Ash pit men	5
Brakemen	59	Boiler washers	5
Boilermakers	51	Checkers	5
Air brake men	48	Messengers	5
Foremen	40	Pumpmen	4
Carpenters	33	Signalmen	4
Handy men	30	Supplymen	4
Hostlers	27	Bolt cutters	3
Blacksmiths	26	Fitters	3
Telegraph operators	25	Switch tenders	3
Watchmen	24	Towermen	3
Pipe fitters	23	Rivet heaters	3
Painters	23	Master Mechanics	3
Cleaners	22	Bridgemen	2
Shopmen	18	Gas men	2
Roundhouse men	16	Lamp tenders	2
Electricians	16	Patternmakers	2
Stationary engineers	15	Toolroom boys	2
Storekeepers	15	Trackmen	2
Oilers	14	Packers	2
Conductors	13	Asst. master mechanic	1
Callers	12	Cook	1
Motormen	12	Draftsman	1
Section men	12	Headlightman	1
Drill press men	12	Plumber	1
Chainmen	11	Tankman	1
Tinsmiths	11	Trainmaster	1
Agents	10	Water service	1
Baggagemen	9	Batteryman	1
Linemen	9	Fire dept. man	1

CENTER PLATE OILER.

By H. C. Stevens, M. M., D. & R. G. R. R., Alamosa, Colo.

There is no doubt but friction in center plates causes many derailments, records of which bear the explanation, "no cause," and such excuses in time become very wearisome to every one concerned. Since inaugurating the practice of oiling center plates a noticeable improvement has been effected in keeping our freight car trucks on the rails, and I attribute it to the oiling of the center plates. We use a cheap grade of summer black oil costing 11 cents per gallon, and ¼ oz. is sufficient for a narrow gauge center plate.

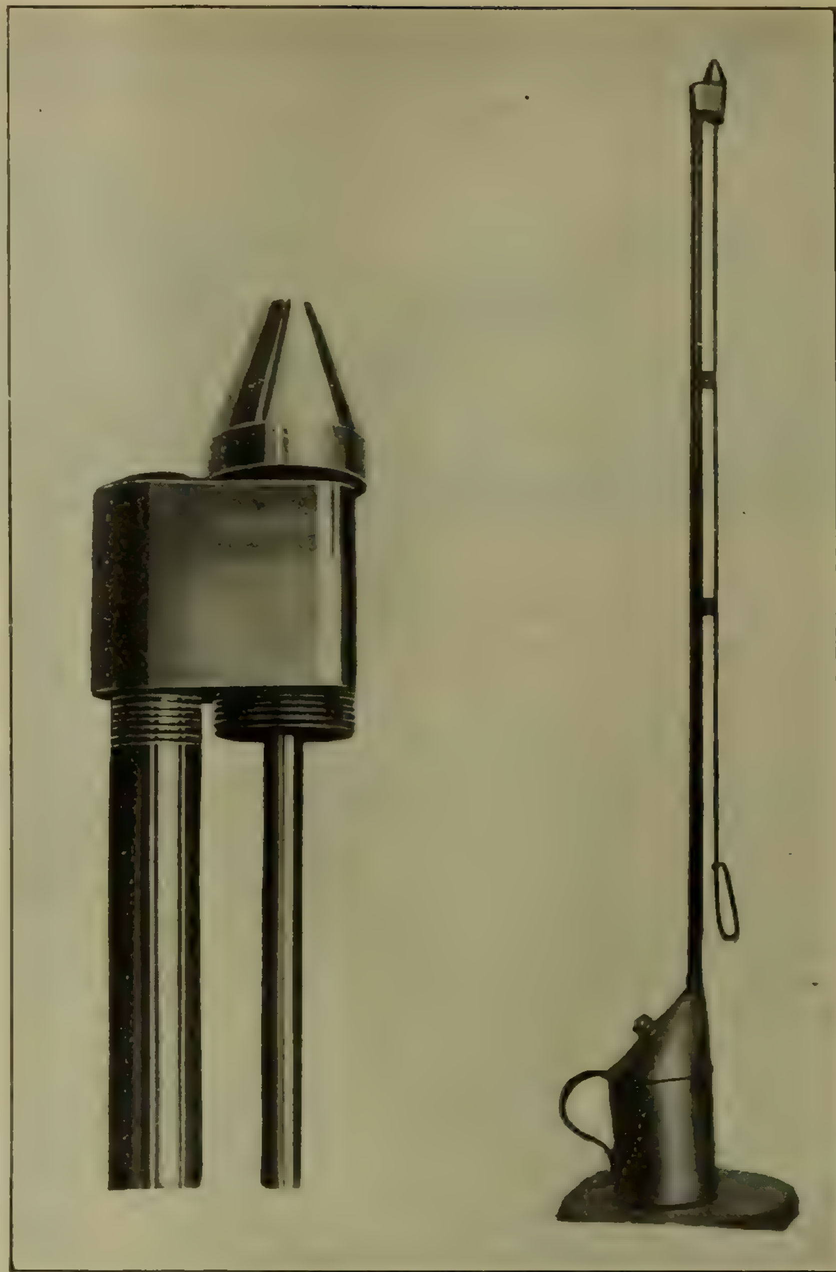
When the oiling began, a helper was detailed to go over the yard oiling all center plates. The long spout oiler used was wasteful of oil, and the most serious objection to that method of oiling was the danger to the oiler, as he was compelled to go under the narrow gauge cars to get at the center plate.

An average of thirty cars oiled to the gallon was about the best we could do with the long spout oiler. With the plain center plate oiler shown in the photographic illustration we increased the number of cars to sixty cars per gallon, or a little over ¼ gill per center plate.

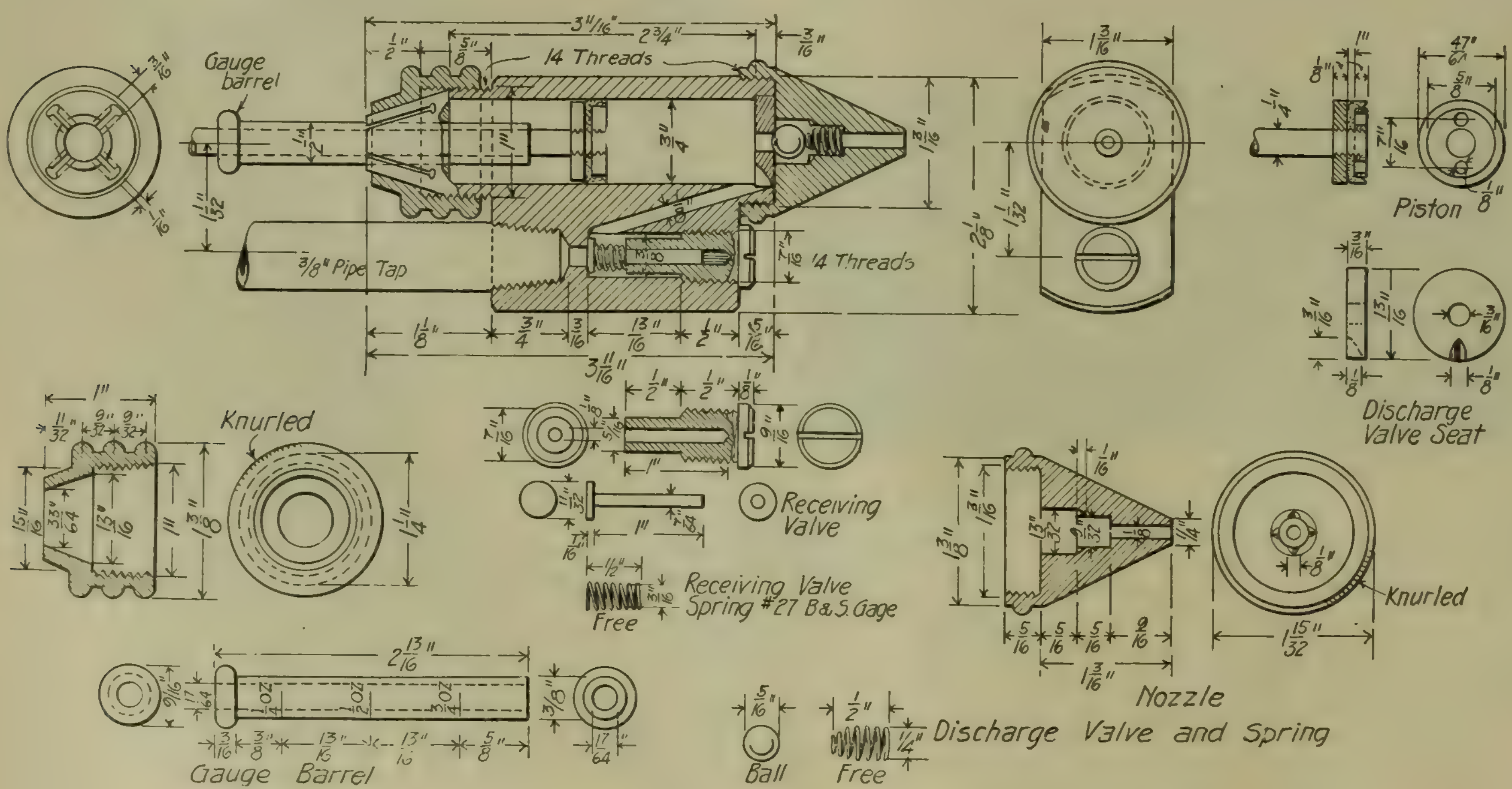
A half gallon can with the valve arrangement attached to four foot pipe is light enough to be handled with ease, and reduces the time of oiling more than three-fourths, and also prevents the man having to expose himself to danger, as all center plates can be oiled with the right amount of oil from outside the trucks.

The plain oiler was such a success as to warrant making it with the graduating arrangement, as we handle both narrow gauge and standard gauge cars, and some of the narrow gauge cars do not require as much oil as the standard.

The Canadian government has ordered railways to equip their locomotives with airtight double windows in front of the the cabs from Nov. 1 to April 30. The order was issued at the request of the Brotherhood of Locomotive Engineers and the Brotherhood of Firemen. It is understood American lines will be asked to follow suit.



Center Plate Oiler with View of Nozzle.



Details of Discharge Valve, Center Plate Oiler.

Electrification of the Butte, Anaconda & Pacific Ry.

The Butte, Anaconda & Pacific Railway is, in many ways, the most remarkable example of steam road electrification in this country. Besides being the first 2,400 volt direct current road, it is also credited with being the first steam road operating both freight and passenger schedules, to electrify its lines purely for reasons of economy. A number of steam railway electrifications have been made because of pre-emptory factors, such as terminal and tunnel operation or for rapid suburban service. This road, however, cannot be closed as an "enforced electrification," since no such special limitations have been the determining factors.

The first electric locomotives were put in service May 28, 1913, hauling ore cars between the East Anaconda yards and the smelter. During the first seven months of service, they made approximately 201,000 miles and hauled about 2,365,000 tons of ore.

The steam locomotive crews consisting of engineman and fireman easily acquired proficiency in handling the electric locomotives; in fact, two or three days' instruction from a competent electrical man were ordinarily sufficient. The change from steam to electric haulage was made without any change in the personnel of the train crews and without any delays or alterations in the schedule. The engineers, without exception, have expressed themselves as being greatly pleased with the easy operation of the locomotives.

The electrified lines of this system extend from the Butte Hill yard to the smelter, a distance of thirty-two miles. There are numerous sidings, yards, and smelter tracks that have been equipped with overhead trolley, making a total of about ninety-five miles on a single track basis.

The Butte, Anaconda & Pacific is essentially an ore hauling road, the freight traffic from this source originating at the copper mines located near the top of Butte Hill. From the mines, the ore trains are lowered down the mountain a distance of 4½ miles to the Rocker Yards located a few miles west of the city of Butte. At this point, new main line trains are made up for transportation to the smelters at Anaconda. The main line division extends through a rough mountainous country, a distance of about twenty miles, with grades as high as 0.3 per cent.

At East Anaconda, the main line trains are broken up and hauled up Smelter Hill to the stock bins, where each car is run over the scales and weighed. The shifting of cars in connection with weighing and subsequent delivery to the concentrators is done by single locomotives.

Map of Electrified Section of the Butte, Anaconda & Pacific Ry.

The eastbound traffic consists in returning empty cars to the mines and the transportation of copper ingot to the Butte yards, where it is shipped over other roads to refineries.

Between the cities of Butte and Anaconda, which are located at the ends of the electrified portion of the system, there is considerable local traffic, both passenger and freight. The city of Butte and vicinity has a population of about 65,000, and Anaconda about 10,000. At Butte, the Butte, Anaconda & Pacific connects with the Great Northern, the Northern Pacific, and the Chicago, Milwaukee & St. Paul; and at Silver Bow, about six miles from the city, connection is made with the Oregon Short Line.

For a distance of sixteen miles, the Butte, Anaconda & Pacific is paralleled by the transcontinental lines of the Northern Pacific, and the Chicago, Milwaukee & St. Paul. The last named company has already contracted for power for the operation of electric trains from Harlowton, Montana, to Avery, Idaho, a distance of 440 miles.

The maximum curvature on the system (20 degrees, 285-foot radius) occurs on the Butte Hill line. On this part of the road, there is an average curvature of 6 to 10 degrees. The locomotives are designed with sufficient flexibility to take a curve of 31 degrees (180-foot radius) at slow speed.

TRAIN SERVICE.

The freight traffic consists largely of copper ore and amounts to more than 5,000,000 tons per year. This material is handled

Overhead Construction in Switching.

Interior of Generator Room in the Rainbow Station of the Great Falls Power Co., Containing Six 6,000-H. P. Units.

Two Unit Electric Locomotive Hauling Freight Train.

in steel ore cars weighing about eighteen tons and having a capacity of fifty tons each. Trains of thirty loaded cars weighing 2,000 tons are made up at the Butte Hill yards and hauled by two-unit locomotives to the Rocker yards, where 4,000-ton trains are made up for the main line. At the East Anaconda yards, the trains are again broken up and 1,400-ton trains are sent up Smelter Hill to the ore bins. All of the shifting and "spotting cars," at the smelters and in the sorting yards, is done by single locomotive units.

Eight passenger trains per day are operated between Butte and Anaconda, four in each direction. The main line trains were first hauled by electric locomotives on October 1, 1913, and promptly demonstrated their ability to make better time than was possible with steam engines. Single locomotives are used, hauling trains of from three to five passenger and baggage cars.

POWER SUPPLY.

Energy for the operation of electric trains is purchased from the Great Falls Power Company. The generating plant is located at Great Falls, Mont., on the Missouri river, and has for some time been supplying electric power for the operation of the mines and smelters at Butte and Anaconda. Six hydroelectric units are installed, having a nominal rated capacity of 21,000 kw. The machines are of the horizontal type, generating 6,600 volts, 3 phase, at a frequency of 60 cycles. The power is stepped up to 102,000 volts for transmission to the transformer substation at Butte, a distance of 130 miles, over two separate parallel lines constructed on the same right-of-way. An extension of the system transmits power at 60,000 volts to a second transformer station at Anaconda, twenty-five miles farther on.

The Butte station forms the center of the extensive power system operated by the Montana Power Company. Besides the Great Falls 102,000 volt transmission lines, there are several 60,000 volt transmissions terminating at this point, which form a part of the Montana Power Company's system. These lines bring in power from the Hauser Lake, Canyon Ferry, Madison and Big Hole plants. At the Butte substation, this power is stepped down to 2,400 volts, 3 phase, and all of these lines are tied in on the 2,400 volt A. C. bus. Ample protection is therefore afforded from interruption of service.

It is an interesting fact that the railway load was taken on without any increase in the high tension transmission facilities. It is estimated that the additional load from this source is approximately 20 per cent of the railway, industrial and lighting load furnished by the street railways, mines, and smelters at Butte and Anaconda.

RAILWAY SUBSTATIONS.

The two existing substations at Butte and Anaconda were used to house the 2,400 volt motor motor-generator sets required for operating the electric trains, so that no additional buildings were constructed for this purpose. Power is furnished by two 1,000 kw., 3-unit motor-generator sets in each substation, taking power from the 2,400 volt A. C. buses. These units operate continuously twenty-four hours per day, seven days of the week, to supply the necessary current for train operation. Each set consists of a 3-phase, 60 cycle, 1,450 kv-a., 720 rpm., synchronous motor direct connected to two 500 kw., 1,200 volt generators, insulated to operate in series for 2,400 volts. The generators are compound wound and have both commutating poles and compensating pole face windings. These fields are connected on the grounded side of the armature, and the main fields are separately excited from 125 volt exciters.

The 1,200 volt generators are provided with heat proof insulation and, owing to their unusually good commutating characteristics, will carry three times normal load for periods of five minutes, as well as the usual 50 per cent, overload for two hours.

An automatic voltage regulator is used to maintain an approximately constant voltage at the terminals of the motor by power factor regulation. The motors are protected against overload by inverse time limit relays, which are set to open at four times normal load. These relays have been adjusted to open under sustained overload in about two seconds and upon short circuit their action is practically instantaneous.

EXCITERS.

Excitation for the two generating units in each substation is obtained from two induction motor driven sets, rated 50 kw. each at 125 volts. One set is used for supplying current to the synchronous motor fields and is controlled by the automatic voltage regulator. The second unit supplies current to the separately excited fields of the direct current generators.

SWITCHBOARDS.

The 2,400 volt switchboards for controlling these sets are the first direct current boards to be constructed for this high voltage. In general, they are similar to the standard 600 volt types with increased insulation and special provision for interrupting the 2,400 volt current. The circuit breakers and switches are also arranged for remote control, and all apparatus on the panels is provided with ample insulation to insure safety to operators.

The 2,400 volt circuit breakers and switches are installed on separate panels above and back of the main panels, and are operated by connecting rods from handles mounted on the front of the main switchboard. These handles are similar in appearance; and to avoid confusion, the circuit breaker handles are inverted. The breakers are equipped with special magnetic blowouts and arc chutes, and provision is also made for automatically inserting a high resistance in the generator field at the same instant the main circuit breakers open, thus reducing the generator voltage.

The alternating current switchboard contains two panels for controlling the synchronous motors by means of remote control, solenoid operated oil switches; two panels for the motor fields, and a panel for the automatic voltage regulator. These panels also contain other necessary instruments, including frequency and synchronism indicators, ammeters, wattmeters and relays.

OVERHEAD CONSTRUCTION.

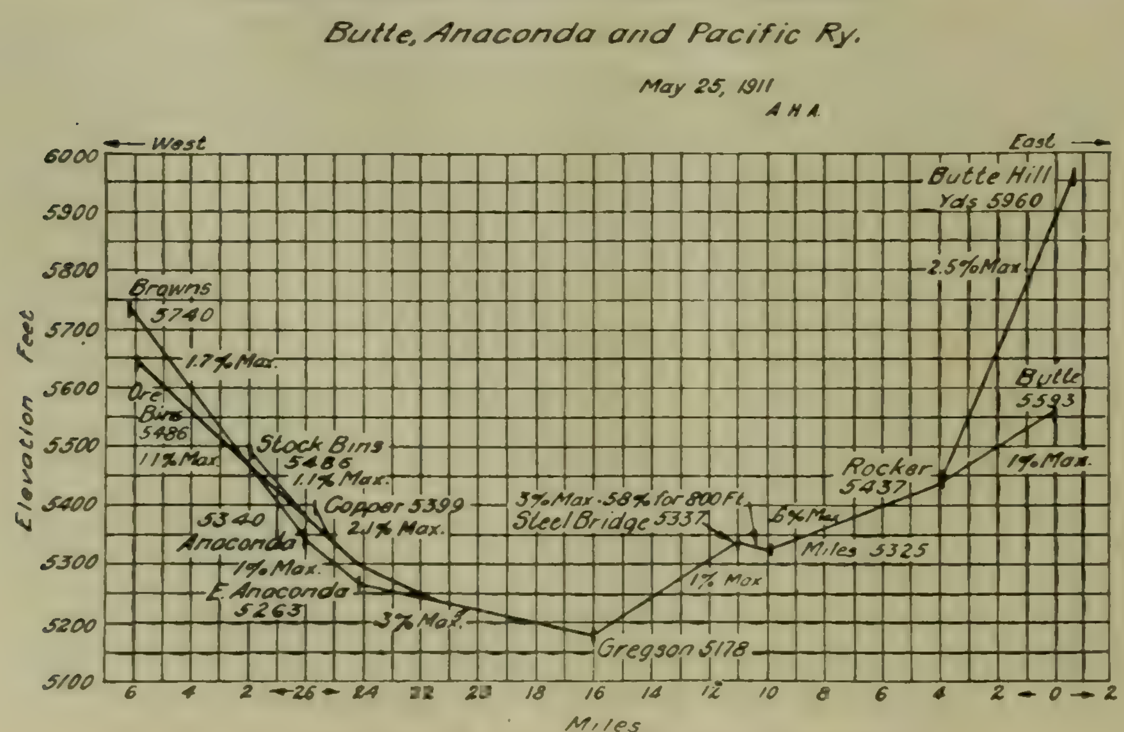
The overhead construction for this system was especially designed to give the flexibility necessary for satisfactory operation of the pantograph trolleys used on the locomotives. The 4/0 grooved copper trolley used over all tracks is supported by an eleven point catenary suspension from a stranded steel messenger cable. Both side bracket and cross span construction are used as required by the local conditions. There is a large amount of special work on account of the many yards and sidings, and in one case twelve tracks are spanned. The cross span construction used at this point is supported by a third pole between the eighth and ninth tracks. The hanger used on the straight line construction is a rolled steel strap looped over the messenger wire. This loop is closed at the car and the wire is clamped in place by a single bolt. Special pulloffs are used to increase the flexibility of the suspension.

The section breakers were designed for the 2,400 volt service, and at six points insulated crossings are necessary at the intersection of the 2,400 volt trolley with the 600 volt trolley of the city system. On the main line a very simple section insulator is used. This consists of paralleling the trolley wires from the ends of each section at a suitable distance for insulation so that the pantograph bridges the two circuits for a short distance, thus avoiding interruption of the power supply to the locomotive. The construction in the yards and sidings is simplified by paralleling the trolley from the side tracks for a short distance along the main line. This avoids the use of switch plates or similar devices. At some of these junction points the pantograph engages as many as six trolley wires.

The overhead lines are protected from lightning by 2,400 volt D. C. typeME arresters installed on poles at intervals of one-third of a mile the entire length of the system.

Single Unit Electric Locomotive and Passenger Train at the Butte Station.

Eighty Ton, 2,400 Volt, D. C. Electric Locomotive.



Profile Map of the Butte, Anaconda & Pacific Ry.

FEEDERS.

The 4/0 trolley is reinforced between the substations with two 500,000 c.m. bare copper cables tapped to the trolley at intervals of 1,000 feet. A 4/0 negative return wire is also installed between Rocker and East Anaconda. This wire is carried on the trolley poles and is connected to the cross bonds at intervals of 1,000 feet. The rails are connected by 4/0 bonds at every joint. The substations are normally connected together by these feeders, allowing an interchange of current. In emergency either station can supply current to the entire system.

LOCOMOTIVES.

The locomotive equipment consists of seventeen 80-ton units, fifteen for the freight and two for passenger service. The freight locomotives are geared for slow speed and are operated in pairs for the main line service. The maximum free-running speed is 35 m.p.h.

The two passenger locomotives are of the same construction as the freight units, but are geared for a maximum free-running speed of 55 m.p.h. A speed of 45 m.p.h. is made with three passenger coaches on straight level track.

The continuous tractive effort of a single 80-ton freight locomotive is 25,000 lbs. at fifteen miles per hour. The maximum tractive effort for a period of five minutes is 48,000 lbs. based on a tractive co-efficient of 30 per cent.

Those locomotives are of the articulated double truck type with all the weight on drivers. The cab contains an engineer's compartment at each end and a central compartment for control apparatus. This cab is of the box type extending the entire length of the locomotive and is provided with both end and side doors. The entire weight of the locomotive is carried on semi-elliptic springs suitably equalized.

The central channels forming a part of the underframe are enclosed and are utilized as a distributing air duct for the forced ventilation of the motors. The air is conducted through the center pins, which are hollow, into the truck transoms and thence to the motors. The engineer's compartment at either end of the cab contains the operator's seat, controller, air brake valves, bell and whistle ropes, ammeter, air gauges, sanders and other control apparatus within immediate reach of the engineer.

The contactors, reverser and rheostats, which are located in the central portion of the cab, are mounted in two banks running lengthwise of the compartment and are conveniently arranged for cleaning, inspection and repair. All apparatus and circuits carrying 2,400 volts thoroughly protected from accidental contact.

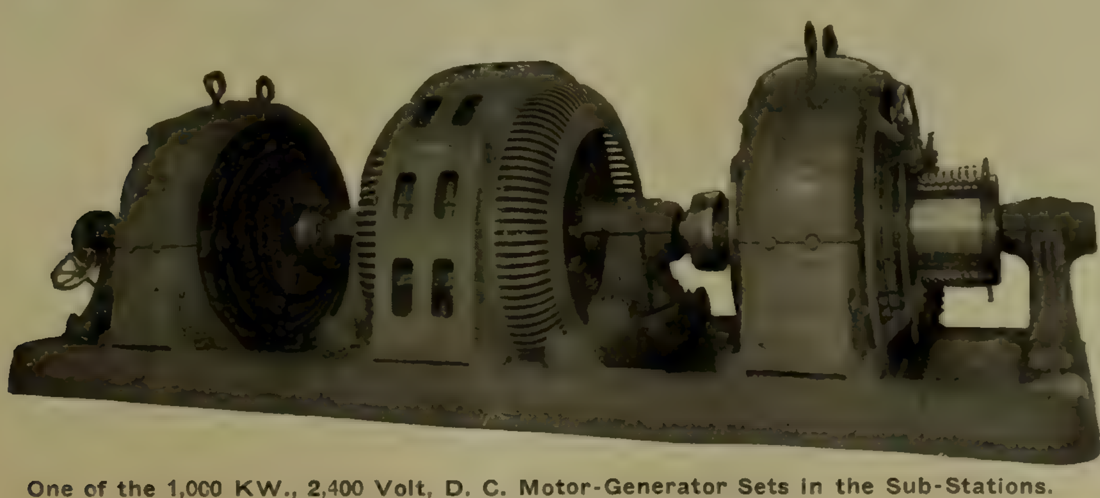
The motors are of the GE-229-A commutating pole type, wound for 1,200 volts and insulated for 2,400 volts. This motor was designed for locomotive service and is provided with forced ventilation. The method of ventilation is similar to the well-known ventilated motors, but the volume of air circulated is increased by the use of an auxiliary blower mounted on an extension of the dynamotor shaft. The gear reduction on the freight locomotive is 4.84 and on the passenger locomotive 3.2. The double unit, 160-ton locomotive is capable of giving a continuous sustained output of 2,100 h. p. The motors are connected to the driving wheels by twin gears similar to those used on the Detroit River tunnel, Baltimore & Ohio, and the Great Northern locomotives.

The control equipment is Sprague-General Electric Type M, multiple unit, operating the four motors in series and in series-parallel. Two 1,200 volt motors are permanently connected in series. The controller provides ten steps in series and nine in series-parallel. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The transfer of circuits at this point is made by a special change-over switch, which is operated electro-pneumatically.

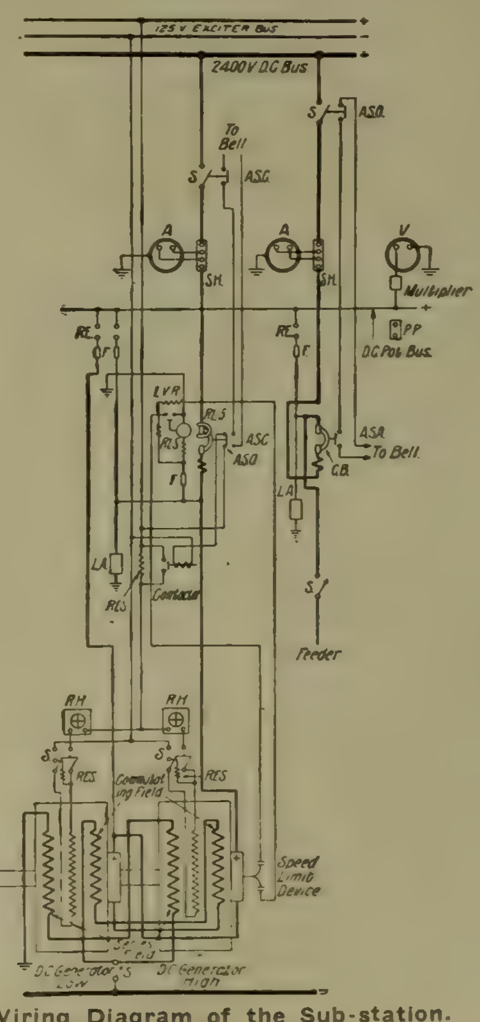
The 2,400 volt contactors are operated from the 600 volt control circuit, and are specially constructed to separate the 2,400 volt part from the coils and interlocks which carry the 600 volt current. The necessary insulation is obtained by large clearances and by the use of porcelain and mica insulation. The armature is connected to the contact lever by a wooden rod. The contacts, magnetic blowout and arc chutes are also especially designed to rupture the 2,400 volt arc.

Current is collected by overhead roller pantographs, pneumatically operated and controlled from either engineer's compartment by an air valve. A 2,400 volt insulated bus line runs along the center of the cab roof. These bus lines are connected together by couplers between the two freight units, so that current may be obtained from either one or two collectors. The air brakes are the combined straight and automatic type; and the compressor is of the CP-26, 600 volt type, having a piston displacement of 100 cu. ft. of air per minute when pumping against a tank pressure of 135 pounds. Radiating pipes are provided on the roof of the cab for reducing the temperature of the compressed air before it reaches the high-pressure cylinder.

For operating the control equipment and air compressor and for lighting the locomotive and cars, 600 volt current is supplied from the 2,400/600 volt dynamotor installed on each locomotive. This machine is similar in construction to the 1,200/600 volt dynamotor installed on each locomotive. This machine is similar in construction to the 1,200/600 volt dynamotor, having two distinct sets of armature coils wound on the same core



One of the 1,000 KW., 2,400 Volt, D. C. Motor-Generator Sets in the Sub-Stations.



Wiring Diagram of the Sub-station.

and brought out to a commutator at each end. One of these windings is designed for 1,800 volts and the other for 600 volts, the two commutators being connected in series across the 2,400 volt circuit. The load current is taken from the 600 volt commutator.

The mechanical load furnished by the direct connected blower supplies sufficient current in the series field windings to provide for the necessary excitation, so that no shunt windings are required. The blower which supplies ventilating air to the motors consists of a multivane fan mounted on an extension of the dynamotor shaft. It has a capacity of 7,200 cu. ft. per minute at four inches pressure.

LOCOMOTIVE DATA.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 in.
Length over cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width over all	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Track gauge	4 ft. 8½ in.
Total weight	160,000 lbs.
Weight per axle	40,000 lbs.
Wheels, steel tired	46 in.
Journals	6x13 in.
Gears, forged rims, freight locomotives	87 teeth
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
Pinions, forged, passenger locomotives	25 teeth
Tractive effort at 30 per cent coefficient	48,000 lbs.
Tractive effort at one hour rating	30,000 lbs.
Tractive effort at continuous rating	25,000 lbs.

The locomotives have been maintained by the regular shop force with the assistance of one man experienced in electrical apparatus.

LIGHTING THE PASSENGER COACHES.

Standard 600 volt lighting fixtures will be used on the cars, and each passenger and baggage coach will be wired for five groups of five lamps in series. The lights in each car will be controlled by a suitable master switch and fuse with snap switches in the individual circuits. Thirty-six watt railway type Mazda lamps are used, giving about 26 c.p. at 110 volts per lamp. Lighting current will be taken from a 600 volt train line bus, which is connected to the dynamotor on the locomotives.

ELECTRIC HOT AIR SYSTEM.

All of the passenger and baggage cars now used between Butte and Anaconda will be heated as well as lighted by electricity as soon as the equipment can be installed. The cars will be heated from a single heating unit installed underneath the car floor and supplied from a 2,400 volt bus connected directly to the 2,400 volt bus on the locomotive. This unit will have a maximum capacity of 25 kw., and will be used to heat the air which is distributed to different parts of the car by means of a small motor driven blower. Cool air will be drawn into the insulated case enclosing the heating units from some point on the roof of the car. After passing over the heating coils the air will be carried through ducts under the floor of the car to radiators placed between alternate seats. The blower has a capacity of from 500 to 1,000 cu. ft. of air per minute, and the motor is connected in series with the heating units.

In order to increase the range of the heating equipment to meet the requirements of varying temperatures, provision is made for connecting the coils to give a total consumption of 10, 15, 17.5, or 25 kw. The temperature of the car is regulated at all times by a thermostat.

All apparatus for the electrification of this road was furnished by the General Electric Company of Schenectady, N. Y.

PYROMETER FOR SUPERHEATER LOCOMOTIVES.

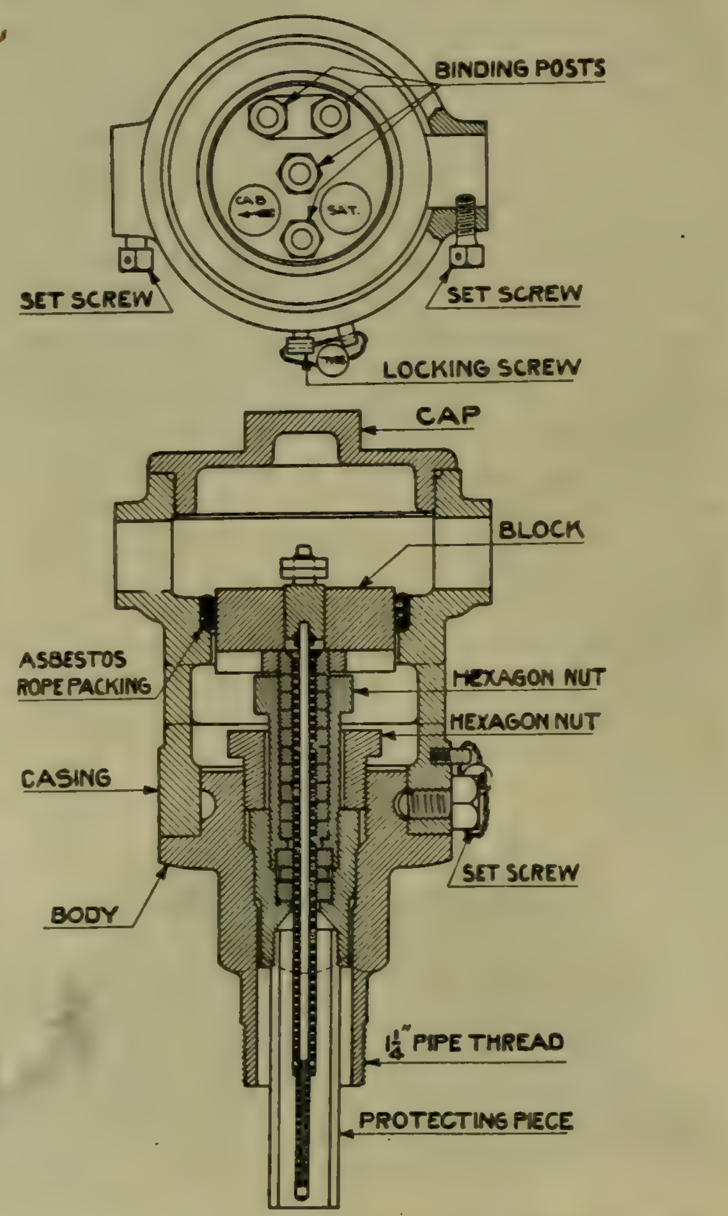
The Locomotive Superheater Co. has issued a bulletin describing a pyrometer developed for use with superheater locomotives. A book of instructions for the use of those installing and operating the pyrometers has also been printed and distributed. Both bulletin and instruction book are copyrighted by the Superheater Co. An extract of the bulletin appears by permission, below:

Recognizing the need of an indicator whereby the engineer could, at all times, be informed as to the temperature of the steam in the steam chest attempts were made to find a suitable pyrometer for this purpose. Several instruments of both the pressure and electrical types were tested and found to be unsuited to the severe conditions under which they would have to operate. In order to get a satisfactory instrument for this purpose it was necessary to develop one that would meet the requirements established by the service in which it must operate.

The conditions to be met with were those of excessive vibration, varying temperatures and atmospheric conditions, as well as the rough handling to which devices on locomotives are subject. To meet these conditions required a delicacy of adjustment and freedom of operation, combined with increased sizes of parts and durability of construction.

The instrument which has been produced and found satisfactory is of the electrical type, consisting of thermo couples, constructed and arranged in accordance with the Bristol system; the cold end located in the boiler, in the saturated steam, and the hot end in the steam chest, directly in the flow of the superheated steam, electrically connected to an indicator of the milli-volt meter type, located on the gauge bracket in the cab.

The ends of the couples are so located that a variation of



Showing Construction of Electro-Thermo Couple and Fitting.

the outside temperatures has practically no effect upon them. The cold end of the couple, placed in the boiler, in the saturated steam, is subject to only the slight variation in temperature due to the variation of the steam pressure, which does not vary more than a few pounds when the locomotive is in operation. The hot end of the couple, placed in the steam chest, in the flow of superheated steam, is subjected to a range of temperatures from that of saturated steam to about 650 degrees. The difference in electromotive force generated by the hot and cold ends of the couples is read directly in degrees Fahrenheit on the dial in the cab.

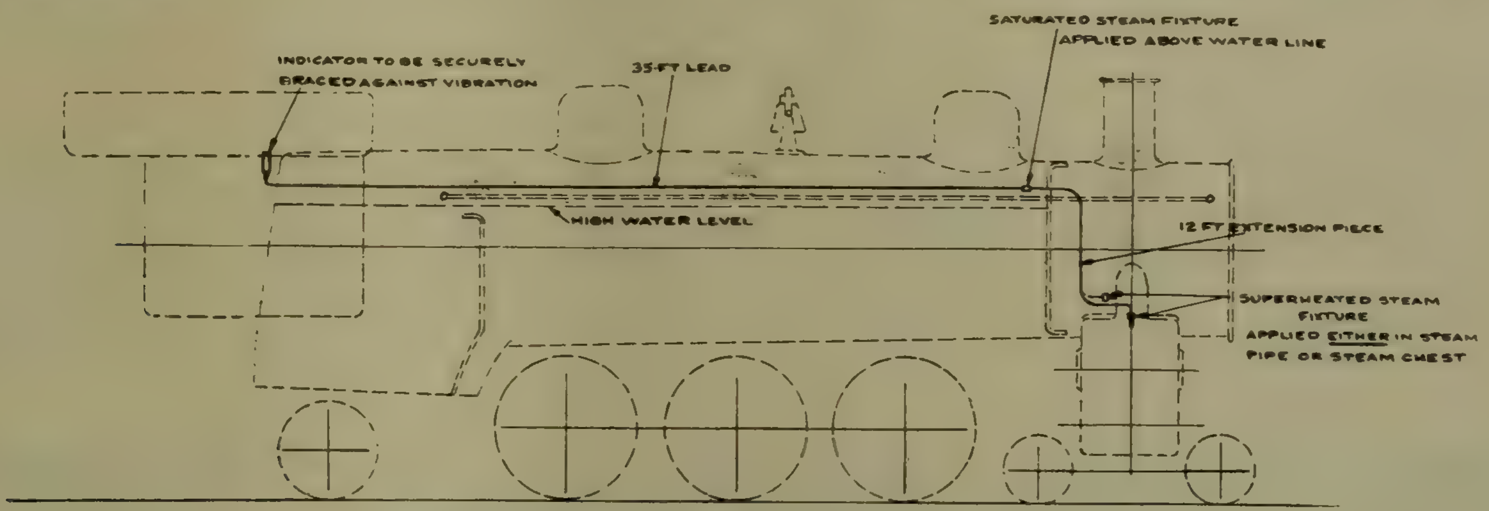
The thermo couples are properly protected against damage and deterioration by suitable fittings of bronze and cast iron, which are screwed into the steam chest and the boiler shell. They are carefully insulated from contact with the boiler shell or the steam chest and are suitably packed to prevent the leakage of steam around them. These fittings are made in such a manner as to completely protect the connection of the electrical leads to the couples, at the same time providing easy access for maintenance.

the throttle closed, there is, of course, no superheat being obtained, and the indicating hand of the pyrometer instrument in the cab is located at the left hand side of the dial, reading between 350 and 390 degrees, assuming that the boiler pressure carried is 200 pounds or less.

As the throttle is opened and the engine starts to work, steam from the boiler passes through the superheater pipes and the superheating process begins. As the engine starts, the pointer will move from left to right on the scale, showing an increased temperature in the steam chest and as the engine is worked harder the superheat added to the steam increases until, under average conditions, the indicator registers between 600 and 650 degrees.

If the pyrometer fails to operate in this manner it shows that either the locomotive is not being operated to produce the best results or that it has not received the proper attention at the roundhouse, and some of the following conditions may be looked for:

First—That the water in the boiler is being carried so high that priming is taking place. The superheater, under this condition, is being used to evaporate the water and the heat which should be superheating the steam is being used for this purpose, a condition which will result in reducing the final temperature of the steam.



Showing Location of Pyrometer Parts on Locomotive.

The electrical lead and extension between the couples and the instrument are designed to provide flexibility and the least amount of deterioration resulting from handling and bending. They are insulated with an especially prepared composition, which is affected by neither moisture nor temperature, and they are finally enclosed within a flexible bronze armor which prevents them from being bruised by substances falling on them.

The instrument itself is of the milli-volt meter, double-jeweled Weston type, the movement having been very carefully designed from a standpoint of accuracy and lightness, in order that it may be depended upon to register accurately the extremely low electromotive force, generated by the thermo couples. At the same time its construction is substantial enough to withstand the vibration and the temperature conditions to which it is subjected. The dial of instrument is graduated to read directly in degrees Fahrenheit, and has a range of from 250 degrees to 750 degrees. The pointer and graduations are carefully selected with the purpose in view of making them distinctly visible at all times, under the light conditions that prevail in a locomotive cab.

The working parts of the instrument are enclosed in a durable cast iron case, so constructed as to be absolutely dust and water proof, built to withstand the severe conditions of locomotive service. The covers of the case and the connection box are held in place by screws, which are so arranged with a sealing wire that they cannot be removed without breaking the seal.

The electrical pyrometer or temperature indicator, as applied to superheater locomotives, is a device which indicates the actual temperature of the steam in the steam chest. Its purpose is to assist engineers and firemen in obtaining the highest degree of efficiency in the operation of superheater locomotives.

When a superheater locomotive is standing or drifting with

Second—The fire may not be in proper condition, due to heavy firing, or occurrence of holes in the fire, which, in either case, results in a reduction of the firebox temperature and consequently the final temperature of the steam.

Third—A portion or all of the superheater flues may be stopped up.

Fourth—There may be leaks in the front end, which interfere with the drafting of the locomotive, preventing the free passage of the gases through the large flues containing the superheater units, thus resulting in a drop in the final temperature of the superheated steam.

Fifth—Failure of the damper to operate properly, which interferes with the circulation of the gases through the flues and results in a reduction of the superheat.

When the pyrometer reading does not show the proper temperature of superheated steam, the engine crew can immediately adjust the height of the water, the condition of the fire, and inspect the operation of the damper. If the indicator still fails to show the proper amount of superheat, the condition should be reported at the terminal at the end of the run.

The roundhouse forces may then investigate the condition of the flues and inspect the front end for steam leaks that may occur there, as well as for the proper operation of the damper, correcting any irregularities that may be found.

The March meeting and annual dinner of the Central Railway Club was held at the Statler Hotel, corner of Swan and Washington streets, Buffalo, N. Y., on Thursday, March 12, 1914.

SAFETY EXHIBIT CAR, N. Y. C. LINES.

The "Safety Exhibit Car" which has been put in service by the safety department of the New York Central Lines, is the first car of its kind to be put in use on any railroad. The car was first opened at Grand Central Terminal on July 30, 1913, and is one of the features of a systematic plan of educating employes along the lines of safety that is being conducted by this railroad. The car is being taken over all of the New York Central Lines, and was equipped and put in commission primarily as an instruction car for the purpose of inculcating the doctrine of "Safety First" in the minds of the employes. The car, however, contains an exhibit that is interesting to the public.

The interior of the car is finished in white enamel. Along both sides of the car is a shelf about three feet from the floor finished in mahogany, which contains models of every kind of machine used in the many shops on the system. The company requires all machines to be properly guarded so as to prevent workmen becoming caught in the various parts and injured. These models show the proper manner of applying these guards. The models of machines are perfect in detail and show at a glance how to make the machines safe.

Along the side walls of the car above the models are several rows of pictures, some of them showing machine guards, and various safety appliances. These pictures are neatly framed and form an interesting and instructive feature of the exhibit. On one side of the car the picture space is devoted entirely to unsafe practices, and there are about two hundred photographs which explain graphically the common practices of railroad employes that cause accidents resulting in injuries to themselves and others. Alongside of a picture showing the improper or unsafe way of doing a certain kind of work, is another picture showing the safe and proper way. Employes will be taken through this car by an attendant and instructed in the matter of safeguarding, not only themselves, but the public from injury.

One section of the picture gallery is devoted to the trespass question and there are a number of pictures showing how persons risk their lives needlessly trespassing on railroad property. Above these trespass pictures is a statement calling attention to the fact that more than ten thousand trespassers are killed and injured annually on railroads in the United States.

At one end of the car is a stateroom and toilet for use of the attendant who will accompany the car over the entire system of the road. Attached to the Exhibit Car there will be a coach which will be used as a lecture car. This car is equipped with a stereopticon and illustrated lectures on safety will be given to employes at various points.

One of the exhibits shows the dangers of certain classes of work when performed without protection for the eyes. The Julius King Optical Company, New York, has collected information illustrating the necessity for eye protection and the results are surprising to those who have not investigated. The goggles manufactured by this concern are used on the New York Central Lines, and are appreciated by the men. The glass is of a quality which does not interfere with eyesight and the frames are made in many adaptations.

The New York Central Lines have a department devoted entirely to safety work and a systematic effort to bring about a reduction of all classes of accidents has been made for some time past. That the work is proving successful is indicated in a statement appearing in a frame in the car, showing that on the New York Central & Hudson River, and Lake Shore & Michigan Southern, two of the New York Central Lines, there were thirty-five fewer employes killed on duty in the first four months of 1913, as against the same period in 1912.

Safety Exhibit Car, New York Central Lines.

REPAIRING AND APPLYING SUPERHEATER UNITS.

By E. J. Brewster, General Foreman, C. & N. N. Ry., Chicago Shops.

A new element has sprung up in the repair of the locomotive of today, consisting of the removing, repairing and applying units and connections of the superheater, which is one of the most efficient appliances applied to a locomotive since its introduction.

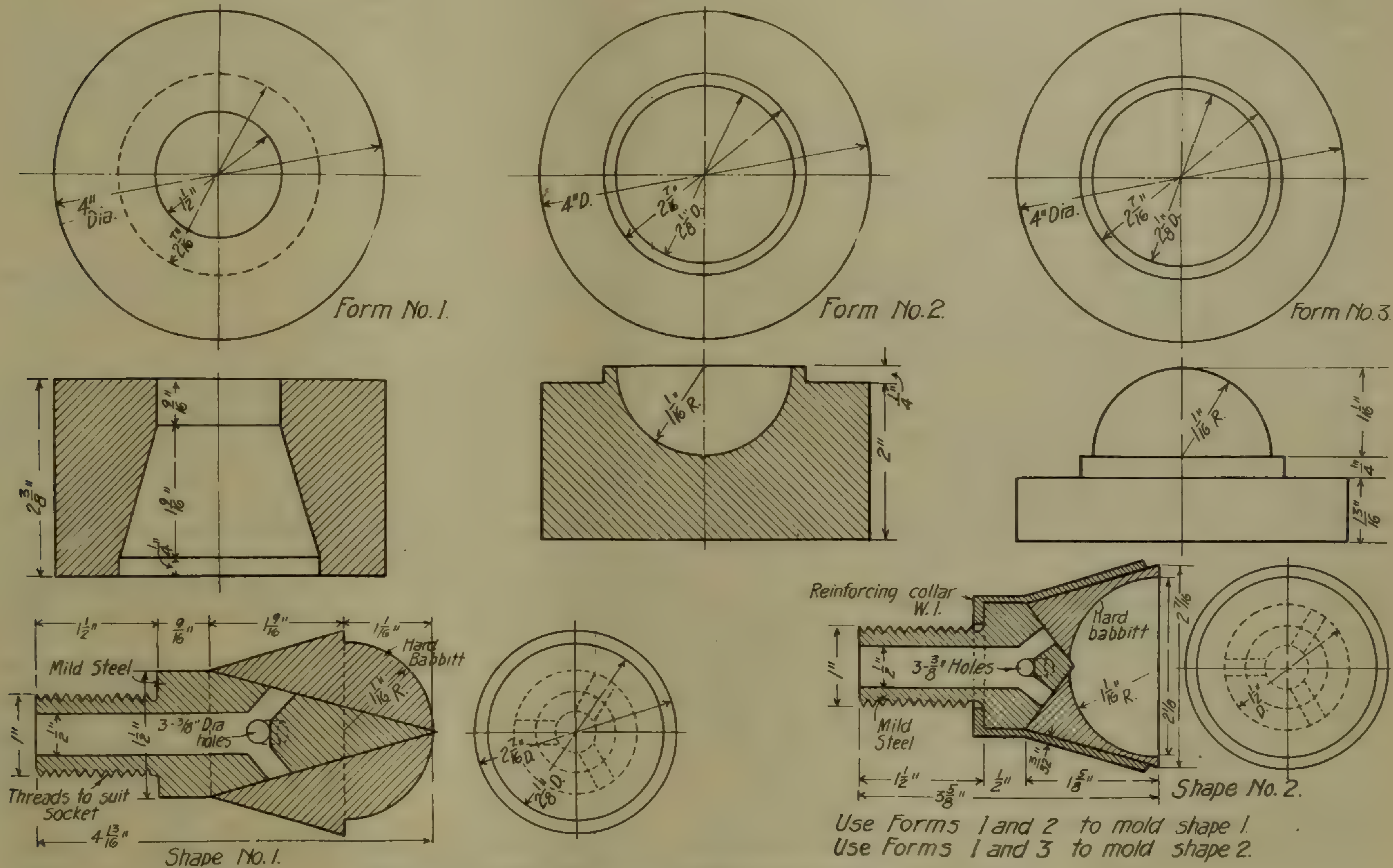
The superheater with which I have had experience is the Schmidt type. The removal of these units is sometimes difficult if the tubes have not been cleaned out, due to a formation on end of units or at unit supports which also retards the efficiency of superheat due to retarding the passage of the hot gases around unit. After removing these units, the first operation is to grind units and header joints. This is quite a proposition unless you are fixed for this work. In order to handle this work quickly, I have devised a set of grinding forms, male and female, cast of any kind of metal in a form which will produce the required form without any kind of machining.

The illustration shows forms Nos. 1, 2 and 3. Form No. 1 is used at all times in making these shapes in connection with forms Nos. 2 and 3. Form No. 2 is the male form and No. 3 the female. In order to first make these grinding shapes, it is necessary to make the shanks as shown, in order to cast these shapes on. These are made of wrought iron, mild steel, or brass with shank threaded to suit any socket for air motor shank, as shown (1" 8 thread U. S. Std.). After shanks have been made, it is necessary to make the forms, which can be made of wrought iron, mild steel, or cast iron.

After shanks and forms are completed, all that is necessary to make shape No. 1 is to put form No. 1 on top of form No. 2 and drop No. 1 shank through hole in top of form No. 1. The point on shank will drop into center of form No. 2, lining it up. Then pour metal through hole in shank until it is full and the shape is ready for use. The same operation for shape No. 2 can be made with forms Nos. 1 and 3.

I also have gauges for trying these shapes and if they get out of shape I simply put them in babbitt pot and melt off shank and pour new shape on shank. Any information in regard to these forms and shapes can be procured from the Locomotive Superheater Co.

In using these shapes, I use a No. 4 Little Giant air motor and in grinding them, give the motor a wabbling motion using carborundum grains No. 50. Do not grind joint too much, as you will find this will grind fast. After grinding unit joints, put on protecting blocks to protect joints, the same as the Superheater Company uses in shipping outfits. Before doing this, test all units for leaks in tubes or return bends by filling with water under pressure.



Forms for Making Shapes for Grinding Superheater Unit Joints.

The next operation is the grinding of the unit seats on header. First clean off and grind by using shape No. 1, at the same time giving the motor a wabbling motion. It is very necessary to get a true joint and seat. After these seats are ground, we are ready to apply units. Put a little oil on seats on header with your finger.

In putting in units, be very careful to not bump or mar joints by striking against header. Joints must come on seats without springing. After one row is applied, slip in bolts and tighten up with a socket ratchet wrench with a bar 30" long. Be careful in tightening up so as to not put excessive strain on bolt, as you are liable to break out slot in header on tee head slot type of header. After first row is in, follow up in the same manner until all are in. Be sure to have supports and band on units, as these are necessary to hold unit in center of tube to allow hot gases to pass all around it. The most essential part of this job is to have good true spherical joints and when this is the case you will have no trouble.

The Soo Line will move from the Illinois Central depot to the Grand Central Terminal at Chicago on April 1, 1914.

The annual convention of the Chief Interchange Car Inspectors & Car Foremen's Assn. will be held at Cincinnati, O., on August 25, 26 and 27, 1914.

EXECUTIVE COMMITTEE MEETING, C. I. & C. F. ASSN.

A meeting of the executive committee of the Chief Interchange Inspectors' and Car Foremen's Association of America, was held in the Karpen building at Chicago on Feb. 21, 1914.

The following officials and members of the executive committee were present:

F. C. Schultze, President, C. I. I., Chicago Car Interchange Bureau.

F. H. Hanson, Vice-President, A. M. C. B., L. S. & M. S. Ry., Cleveland, Ohio.

Stephen Skidmore, Secretary and Treasurer, F. C. D., C. C. C. & St. L. Ry., Cincinnati, Ohio.

F. W. Trapnell, Chairman Executive Committee, chief interchange inspector, Kansas City, Mo.

Members of the executive committee:

J. J. Devaney, F. C. D., Terminal Railway Association, St. Louis, Mo.

J. P. Carney, G. C. I., Michigan Central R. R., Detroit, Mich.

W. J. Stoll, chief interchange inspector, Toledo, Ohio.

E. R. Campbell, G. C. F., M. T. Ry., St. Paul, Minn.

Fifty car foremen, representing the various Chicago roads, were present and took part in the discussion.

The meeting was presided over by F. W. Trapnell, chairman of the executive committee. The following recommendations for changes in the M. C. B. rules were recommended to the Arbitration Committee of the M. C. B. Association.

RULE 1.

Each railway company *must* give to foreign cars, while on its line, the same care as to inspection, oiling, packing, adjusting of brakes and *repairs* that it gives to its own cars.

Reason: The words, "running repairs" is not generally understood by the car foremen, some claiming that this simply means that such repairs as applying wheels, draft timbers, draw bars, etc., are meant by "running repairs."

Each railway company should give the same attention in the way of repairs to foreign cars while on their line, as it does to its own cars, until such time as the car gets in a wornout unserviceable condition, as provided for in Rule No. 120.

Add second paragraph: Oil boxes not found repacked within twelve months, may be repacked and charged to the car owners, car to be properly stenciled at a convenient location.

Reason: Many car owners neglect to take care of the packing in their cars, and as a result, the cars run hot and journals are cut due to journals not receiving the proper attention. Experience has proven that oil boxes should be repacked at least once every twelve months.

RULE 2.

Change first paragraph to read as follows:

Cars having defects for which delivering company is responsible must be properly carded when interchanged.

Reason: It is the general practice to inspect cars in the receiving line's yard, and this is good practice for the reason the receiving line is the judge.

Change second paragraph to read as follows:

Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge. Owners must receive their own cars, when offered home for repairs, at any point on their lines, also foreign cars originating with them, when offered at originating point, subject to the provisions of these rules.

Reason: The present rules permit the receiving line to technically object to foreign cars offered that have been away from their line for a short period. This suggestion compels the delivering line to take the cars back in the same general condition as when delivered. This is necessary in order not to delay foreign cars that are on their way home.

Change third paragraph to read as follows:

Leaking cars containing inflammable liquid must be repaired or transferred without any unnecessary movement, or at nearest available point, with least possible risk.

Reason: The above suggestion eliminates the word "tank" from the rule, for the reason that it is just as dangerous to handle cars containing inflammable material in packages as it is in tank cars.

Paragraph (e).

It is recommended that the official clearance be published in the M. C. B. rules, for the reason that it is not feasible to place in the hands of inspectors where they are readily available, publications in which the official clearances are now published.

RULE 3.

If a car has defects for which the owners are not responsible, the receiving line shall require that a defect card be securely attached to the car, as per Rule 14.

Defect cards shall not be required for any damage that is so slight that no repairs are necessary; at outlying points where joint inspection is not in effect, the matter will be left to the judgment of the receiving line; at the larger points where chief interchange inspectors are employed, the decision will be made by the chief interchange inspector as a representative of the car owner and the receiving line.

RULE 9.

Fourth bracket. first line.

Change the words "make or name" to "M. C. B. No. 1 or No. 2."

RULE 14.

Change rule 14 to read as follows:

The end of car toward which the cylinder push rod travels shall be known as B end and the opposite end shall be known as A end.

Facing the B end of car, in their order on the right side of car, the journal boxes and contained parts shall be known as, BR 1, BR 2 and BL 1 and BL 2. Facing the A end of car, the journal boxes and contained parts shall be known as, AR 1, AR 2 and AL 1 and AL 2; the same to apply to defects upon the body of the car; the center of the car to be the dividing line.

We further recommend that a diagram be inserted in the M. C. B. Rules showing the various locations on body as well as trucks. Diagram to be as shown below:

Reason: It is found necessary, that in order to locate damage upon the body of the car, the rule should be changed as outlined above, and the diagram will be a guide to the interchange car inspectors.

RULE 17.

Change the first line in the third paragraph to read:

"Malleable iron or steel M. C. B. Standards," etc.

RULE 18.

Add to the third paragraph of rule 18.

"Unless enroute home."

Reason: This will permit the cars to move home to the owners after October 1st, 1914.

RULE 19.

Change the last line to read:

"Malleable, filled, or steel backed journal bearings."

Reason: To permit the use of the filled bearings.

RULE 35.

Add paragraph to this rule.

"That on and after October 1st, 1915, cars of 40,000 lb. capacity will not be accepted in interchange."

Reason: Cars of 40,000 lb. capacity are not considered safe in heavy trains.

RULES 37, 38, 39 AND 40.

These rules should be eliminated.

Reason: The majority of defects resulting in damage as enumerated in rules 37 to 40 inclusive, are the result of poorly constructed and weak cars, for which the car owner is responsible and which give away in ordinary handling. The elimination of these rules also permits extensive repairs to be made to foreign cars which will result in the life of the cars being extended and cars kept in more serviceable condition, as outlined in recommendation made in M. C. B. rule No. 2.

RULE 41.

Change to read:

"Damaged longitudinal sills, if necessitating replacement or splicing of more than three sills."

Reason: The majority of wooden center sills become defective by the bolt holes wearing oblong which is an owner's defect. The adding of one additional sill will make the delivering line responsible for rough usage.

RULE 42.

Eliminate.

Reason: As for rules 37 to 40 inclusive.

RULE 46.

Add after word "risk" also if equipped with contrifugal dirt collectors.

RULE 47.

Eliminate.

Reason: That the chains in interchange are protected by being way-billed as advanced charges by the agent. Under the present practice of returning chains, many chains are returned which are being settled for through joint freight agents by advanced charges.

RULE 52.

Eliminate first paragraph and substitute the following:

"All safety appliances when renewed or removed for repairs must be secured in accordance with Interstate Commerce Commission requirements."

Reason: On such cars where it is necessary to remove or renew such parts, they should be made to require with the Interchange Commerce Commission requirements.

RULE 59.

In the seventh line eliminate the words "on account of insecure fastenings" and substitute the words "unless damaged by derailment or accident."

Reason: This makes car owners responsible for broken air brake fittings unless car has been accepted or in accident.

RULE 60.

Add to the first paragraph of last line, "old dates must be thoroughly obliterated."

Reason: It is found in many cases old dates are not being removed resulting in confusion.

RULE 68.

Add to paragraph 1:

"Except in cases of flat spots of 2" or over on cars of 80,000 capacity or over, should be made delivering line defects."

Reason: It is felt that slid wheels of 2" on cars of 80,000 capacity or over are dangerous and should be removed.

RULE 69.

Eliminate from this rule after the figure 78, the word "broken."

Reason: This will eliminate chipped flanges as a delivering line defect. It is felt that many flanges are chipped in ordinary handling for which the car owner should be responsible.

RULE 82.

Eliminate the word "the" in the first line, and in the second line the words, "opposite," "from" and "throat," and substitute after the word "on," the word "either." This will include flanges chipped on both sides owner's defect and increase length of the chip from 1½ to 1¾.

Reason: It is felt that the present dimension of a chipped flange is too small, and also under all conditions, all flanges should be an owner's defect, except in case of derailment or accident.

RULE 83.

A gauge should be provided showing a slid flat spot of 2".

Reason: To take care of change provided in rule No. 68.

RULE 84.

Eliminate from this rule the words "cut journals."

Reason: It is felt that cut journals are due to the carelessthe car owner, and same should be an owners defect. It is also noticed that defect cards in interchange are demanded by the receiving line for journals that are slightly cut and where the brass and other parts are in perfect condition, which cannot be discovered in ordinary inspection in interchange.

RULE 85.

Change to read:

"Cut journals, axles broken of having seamy journals."

Reason: To comply with change recommended in rule 84.

RULE 86.

It is felt that there is a typographical error in the size shown of wheel seats for 79,000 limit weight axles. This 79,000 dimension compares with the 50,000 capacity axle, and the maximum M. C. B. size for the wheel seat on a 50,000 capacity axle is 5⅛". This exceeds the size by ⅛ inch. The same limit applies to limit weight No. 2.

RULE 93.

Add the words:

"Unless otherwise designated in The Equipment Register."

RULE 94.

Change this paragraph to read:

"For repairs made on defect cards, the card must accompany the bill as voucher for the work done, but no bill shall be rendered for repairs that have not been made, except when cars are taken out of service by the owner and dismantled, in which case bill may be made against the road issuing defect card for cost of material only. In case of car dismantled on intermediate line bearing a defect card, the handling line has authority to bill the road issuing the defect card for 50% of the value of defect card."

Reason: It is felt that the car owner is entitled to be reimbursed for loss of his car which in many instances was fit for a number of years of service, and it is felt that he should be entitled to bill the road responsible for damage for the cost of material, but no labor for the reason that no labor was expended.

RULE 98.

Attention of the Arbitration Committee is called to the fact, that in the operation of the present rule, there has resulted in many usable second hand wheels being left on the hands of the railroad companies, and it is felt that some method should be worked out for which the railroad companies may be permitted to use the good second hand wheels. It is also suggested that a price be provided for a 33 inch cast wheel which weigh more than 625 lbs. for the reason, that such wheels are

now being applied by railroad companies and a price should be provided for same.

Attention of the Arbitration Committee is also called to the fact that it should be permissible to bill the car owner in many cases for the application of the opposite wheel.

RULE 101.

Add an item after the second item under "material" "Brake beams No. 1 and brake beams No. 2" with the proper credits.

RULE 104.

Additional recommendation:

"In case of defective brake beams removed when another make is applied, credit shall be confined to the beam section, heads, fulcrum and truss rods on trussed beams."

RULE 107.

The Arbitration Committee's attention is called to the following items in rule 107:

"Hand holds straightened on car, one or two."

"Turn buckle," insert "uncoupling lever renewed." And under the item "truck springs one or all in the same truck renewed" add item "truck springs replaced one or cluster when out of place, empty car," "one under bolster and price for both ends of bolster."

The Arbitration Committee's attention is called to the fact that a price should be provided for making a double splice on side sills in the center of the car; for the reason; at the present time a single splice is made on side sills so as to renew that part of the side sill under the side door post, and the present charge of a double slice is made which is excessive.

RULE 110.

After the second paragraph on page 75 insert the following:

"Applying center plate bolts, when one or two long draft timbers are applied, when the bolts are removed on the opposite timber, they should read one timber."

RULE 113.

"For the mutual advantage of railroad companies interested, the settlement for a car when damaged or destroyed upon a private track shall be assumed by the railway company delivering the car upon such tracks," except in cases of cars delivered upon the owner's track."

Reason: Under the present rule, the owner of a private car has no redress for loss of his car destroyed upon a private track. It is unfair to discriminate between private and railroad owned cars.

RULE 115.

In the first line of the second paragraph it is recommended that the item 50,000 be changed to read 60,000.

RULE 116.

The attention of the Arbitration Committee is called to the fact that in the settlement prices for bodies of eight wheel steel cars, the second item is less in price than it is for the fifth item, the latter being $10.00 greater. It is felt that this is a mistake and the second price should be reversed.

On page 86 of the same rule, it is recommended that a paragraph be inserted, allowing for additional arbitrary allowance for cars equipped with all steel ends and all steel roofs.

Reason: Many cars are not being so equipped with this additional expense and the car owner should have attention.

RULE 117.

Add to this paragraph the words:

"Except when owners authorize the destruction of the cars in accordance with Rule 120, in which case scrap credit should be allowed for the different metals under M. C. B. rules, to conform with circular 18."

RULE 120.

The following rule was recommended:

"A car unsafe to load on account of general worn out condition due to age, decay or corrosion, shall be jointly inspected by the handling line and a representative of the owner or dis interested line, whichever can be most conveniently obtained by the handling line. If inspectors agree that home route cards are justifiable, joint inspection shall be sent to owner showing in detail, all defects found on car, and upon receipt of this information the car owner shall either furnish authority authorizing the handling line to either make repairs or destroy car at the owners expense and allow the proper credit for scrap.

Reason: Cars that have become in a general worn out, unserviceable condition, should be either rebuilt or destroyed at the car owners expense.

It is also felt that a uniform price should be made for the dismantling of cars of various capacities.

RULE 121.

This rule should be eliminated.

Reason: When cars cannot be handled under M. C. B. Rule 2 they should be repaired or destroyed by the handling road.

RULE 121 A.

Following is recommended:

"A car having a combination of defects due to ordinary wear and tear and not account of unfair usage as provided by these rules, shall be jointly inspected by the handling line, and a representative of the car owner or disinterested line. If this joint inspection shows defects are properly chargeable to the car owner, the handling line shall be furnished with authority to bill."

RULE 122

In the last paragraph eliminate the word "hairfelt."

Reason: It is felt that it is not practicable to have this class of material on hand at all times.

RULE 124.

Additional paragraph should be inserted empowering the Arbitration Committee to have the arbitration decisions revised from time to time so as to eliminate all obsolete decisions, that are not consistent with the current M. C. B. Rules.

On page 98, M. C. B. return card. It is recommended the wording of this card be changed to read: Return card, car .... number .... and the word "from" to "to," so that it will be understood by trainmen.

The attention of the Arbitration Committee is called to the fact that A. R. A. Car Service Rule 15 should be changed by omitting the first three words in the first paragraph which read "unless otherwise agreed."

It is felt that the elimination of these three words would result in A. R. A. Rule No. 15 being uniformly adopted throughout the United States and Canada, and for the further reason, it is inconsistent to accept cars at one terminal under one rule and be obliged to transfer them before cars will pass to the next terminal. The transferring and rearrangement of cars should be uniform.

It is also recommended that another addition be added after paragraph F to read as follows:

"The initial road shall pay the cost of transfer or rearrangement of closed cars when transfer or rearrangement is due to contents being improperly loaded according to M. C. B. loading rules."

Reason: It is found that under M. C. B. loading rule No. 124 the delivering line is held responsible for load shifting and lack of door protection, which defects they cannot detect in ordinary inspection upon receipt from connecting line, and it is felt that the originating line shall be responsible.

PASSENGER CODE OF RULES.

Add a paragraph as follows:

"Equipment and tolls missing from the inside of baggage, mail and express cars is an owner's defect when found at the time of unloading."

Reason: Baggage cars usually pass in interchange with

doors locked or sealed and there is no opportunity of inspection until the time of unloading.

It is also recommended that a standard steam hose should be adopted for the reason that it is very inconvenient to change steam hose on passenger cars moving in interchange, and for the further reason, that the road removing the hose has no use for same as it is not standard to their cars, and in many cases cars are returned by a different route and hose cannot be utilized.

It is recommended for the convenience of inspectors and foremen that changes in the M. C. B. rules hereafter be printed either in italics or small capitals so that changes can be readily noticed.

ANNUAL CONVENTION.

A number of cities made application for the next annual convention, and it was finally decided to hold it at Cincinnati on August 25th, 26th and 27th.

Personals

W. A. Deems has been appointed general foreman of the Glenwood shops of the *Baltimore & Ohio* at Pittsburgh. He was formerly general foreman of the Cincinnati, Hamilton & Dayton at Lima, O.

S. D. Page has been appointed general car foreman of the *Bangor & Aroostock*, with office at Milo Junction, Me. He succeeds H. A. Martin.

W. H. Keller has been appointed general foreman of the *Cincinnati, Hamilton & Dayton* at Lima, O., succeeding W. A. Deems. Mr. Keller was formerly general foreman of the Baltimore & Ohio Southern at Flora, Ill.

R. Preston has been promoted to assistant superintendent of motive power of the western lines of the *Canadian Pacific* with office at Winnipeg, Man.

J. A. Moore has been appointed car foreman of the *Canadian Pacific* at White River, Ont., vice F. Guy.

H. Osborne has been appointed assistant mechanical superintendent of the *Canadian Pacific,* with office at Montreal. His former title was assistant superintendent of motive power.

W. E. Woodhouse has been appointed superintendent of motive power of the *Canadian Pacific,* Eastern Lines, with office at Montreal, Que. Mr. Woodhouse was formerly assistant superintendent of motive power at Winnipeg.

F. R. Pennyfather has been appointed master mechanic of the Manitoba division of the *Canadian Pacific,* with office at Winnipeg, Man., vice R. Preston.

W. J. Renix has been promoted to district master mechanic of the *Canadian Pacific* with office at Cranbrook, B. C. He succeeds F. R. Pennefather, promoted.

C. Perry has been promoted to general foreman of the *Canadian Pacific* at Sutherland, B. C., succeeding W. J. Renix. Mr. Perry was formerly shop foreman at Brandon, Man.

G. W. Robertson, formerly master mechanic of the Ashland division of the *Chesapeake & Ohio,* has been appointed master mechanic of the Hinton division, with headquarters at Hinton, W. Va.

W. S. Butler has been appointed master mechanic of the Huntington and Big Sandy division of the *Chesapeake & Ohio* with headquarters at Huntington, W. Va. Mr. Butler was formerly master mechanic at Hinton, W. Va.

W. P. Hobson, master mechanic of the Cincinnati division of the *Chesapeake & Ohio,* has had his jurisdiction extended over the Ashland division. His office remains at Covington, Ky.

Emil Marx succeeds G. C. Bingham as general foreman of the *Chicago & Northwestern* at Winona, Minn.

F. Davidson has been appointed purchasing agent of the *Chicago, Indianapolis & Louisville,* with office at the Transportation building, Chicago.

R. E. Wood has been appointed road foreman of equipment of th *Chicago, Rock Island & Pacific* with office at Pratt, Kan.

E. I. Partlow has been appointed road foreman of engines of the *Cincinnati, Hamilton & Dayton,* succeeding R. W. Brown.

H. Booth succeeds M. W. Sullivan as road foreman of engines of the *Delware & Hudson,* with office at Carbondale, Pa.

W. E. LeFaivre succeeds Thomas Tipton as purchasing agent of the *Denver & Rio Grande* with office at Denver, Colo.

George Gilmore has been appointed foreman of the *Detroit, Toledo & Ironton* at Delray, Mich.

J. Coots has been appointed supervisor of locomotive operation of the *Erie,* with office at Jersey City, N. J.

J. Cunneen has been appointed supervisor of locomotive operation of the *Erie,* with office at Jersey City, N. J.

H. Evans has been appointed foreman of the *Grand Trunk Pacific* at Rivers, Man., vice R. W. Moore, transferred.

D. W. Hay, locomotive foreman of the *Grand Trunk Pacific,* has been transferred from Redditt, Ont., to Jasper, B. C.

F. Lozo, locomotive foreman of the *Grand Trunk Pacific,* has been transferred from Jasper, B. C., to McBride, B. C.

A. H. Mahon, locomotive foreman of the *Grand Trunk Pacific,* has been transferred from McBride, B. C., to Prince George, B. C.

H. Darling has been appointed locomotive foreman of the *Grand Trunk Pacific* at Smithers, B. C.

H. Saunders, car foreman of the *Grand Trunk Pacific,* has been transferred from McBride, B. C., to Fort George, B. C.

A. K. Leighs has been appointed car foreman of the *Grand Trunk Pacific* at McBride, B. C.

Clarence Fife succeeds J. P. Cooney as locomotive foreman of the *Great Northern* at Casselton, N. D.

Charles F. Barnhill succeeds the late A. B. Adams as master mechanic of the *Gulf, Colorado & Santa Fe* with headquarters at Silsbee, Tex.

Millard F. Cox has been promoted to assistant superintendent of motive power of the *Louisville & Nashville,* with office at Louisville, Ky. Mr. Cox was formerly mechanical engineer.

James Fahey succeeds L. M. Hunter as traveling engineer of the *Nashville, Chattanooga & St. Louis,* with office at Nashville, Tenn.

J. F. Hoyer has been appointed purchasing agent of the *New Orleans Great Northern,* with office at 505 Millsap building, Jackson, Miss. He succeeds F. L. Kinsman.

W. B. Geiser has been appointed acting chemist and engineer tests of the *New York Central & Hudson River,* with office at West Albany, N. Y. He succeeds R. W. Mahon.

James O'Neal, formerly general foreman, car department of the *New Orleans, Mobile & Chicago,* has had his title changed to master car builder.

C. C. Elmes has been appointed assistant engineer of motive power of the *Philadelphia & Reading,* with office at Reading, Pa.

Charles A. Bingaman has had his title changed to assistant engineer of the *Philadelphia & Reading,* with office at Reading, Pa. His former title was engineer of tests.

R. B. Rasbridge has been appointed superintendent car department of the *Philadelphia & Reading* with office at Reading. Mr. Rasbridge was formerly chief car inspector.

R. D. Wilson has been promoted to general car inspector of the *Philadelphia & Reading,* with office at Reading, Pa.

T. E. Hessenbruch has been appointed assistant general car inspector of the *Philadelphia & Reading* with office at Reading, Pa.

W. E. Grove has been appointed inspector, car department, of the *Philadelphia & Reading* with office at Reading, Pa.

E. T. Worman has been promoted to general foreman of the *Rutland* with office at Malone, N. Y., succeeding C. V. McMaster.

H. F. Holden succeeds E. T. Worman as road foreman of engines of the *Rutland* with office at Rutland, Vt.

D. C. Fitzgerald, assistant general superintendent of motive power of the *St. Louis & San Francisco,* has resigned.

J. H. Ruxton has been appointed superintendent of motive power of the *San Antonio, Uvalde & Gulf* with headquarters at Pleasanton, Tex.

LEWIS D. FREEMAN has been appointed shop engineer of the *Seaboard Air Line* with office at Portsmouth, Va. Mr. Freeman was formerly chief draftsman of the Kansas City Southern at Pittsburg, Kan.

H. G. WHITE has been appointed general foreman of the *Southern* with office at Atlanta, Ga.

T. W. HEINTZELMAN has been appointed general superintendent of motive power of the *Southern Pacific* with headquarters at San Francisco, vice H. J. Small, retired.

T. W. YOUNGER succeeds T. W. Heintzelman as superintendent of motive power of the northern district of the *Southern Pacific* with headquarters at Sacramento, Cal.

SAMUEL F. CLARK has been appointed purchasing agent and general storekeeper of the *Spokane, Portland & Seattle* with headquarters at Portland, Ore. He succeeds J. F. Mahoney.

D. C. WILSON succeeds A. J. Collett as electrical engineer of the *Union Pacific* with office at Omaha, Neb.

OBITUARY.

A. B. ADAMS, master mechanic of the *Gulf, Colorado & Santa Fe* at Silsbee, Tex., died on February 16.

D. C. IDLER, for many years master mechanic of the *Vandalia,* died at Indianapolis on February 23.

New Books

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS. Proceedings of the twenty-fifth annual convention. Cloth, 6x9½ inches, 612 pages, unillustrated. Published by the Law Reporting Co., 115 Broadway, New York. Price, $1.

This volume includes all the committee reports and discussions given before the annual convention held at Washington, D. C., on October 28-31, 1913. This association has some twenty committees covering such subjects as car service, express service, grade crossings, legislation, powers of commissioners, railway taxes, rates, capitalization, safety appliances, statistics, shippers' claims, telephones and telegraph service, uniform classification, rails and equipment, and valuation. As the membership of the organization is composed of state and national railway commissioners, the topics discussed are of particular interest as giving the views of these officials on the various questions and the book is well worth having for this purpose.

Among The Manufacturers

KNIFE GRINDER.

The need for a machine that will quickly and accurately grind the knives of planers and jointers without the trouble of taking the knives off the machine has for some time been recognized by users of wood-working machinery.

The time spent in removing knives and putting them back properly adjusted is a difficult and unsatisfactory task. The work is often done hurriedly and improperly, resulting not only in poor work, but inefficiency in production.

This is especially true of the thin, hard knives used on modern cylindrical head planers which it is almost impossible to grind on an automatic, and reset knives in perfect alignment the entire length of head.

The requirements of a knife grinder are that it must grind true, must be adaptable to all makes and sizes of planers, must be easily attached, and must be light enough to be easily carried from machine to machine.

In the "Quicsharp" grinder these requirements have been combined. This grinder is motor driven, the motor being mounted in grinder head, and current is taken from an ordinary lamp socket. To the saddle is attached a split nut engaging the feed screw which lays along the top of bridge. This saddle can be fed the length of the bridge in either direction and at any speed desired, the bridge being supported at the ends, or any point most convenient, by two angular brackets which are bolted to the jointer bed, holding the grinder perfectly rigid. The grinding wheel, which is cup-faced, can be raised or lowered by a thumb-screw and can be set to grind the required amount from knives, automatically feeding itself to a positive stop. A tension spring maintains a constant and uniform pressure on the grinding wheel, but never too much, thus eliminating all danger of overheating and burning the knives.

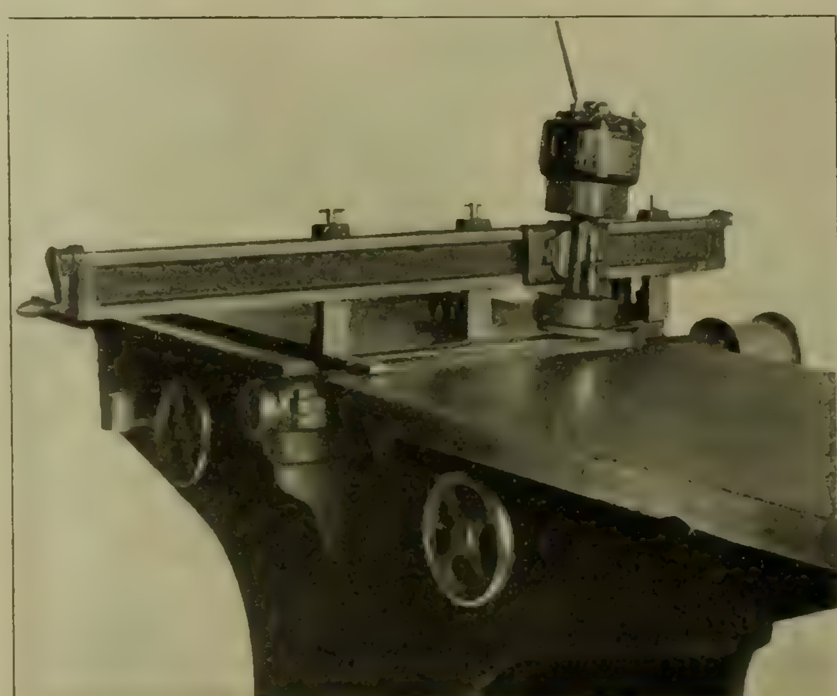
The grinder head is pivoted at the center and can be tilted to either side of the perpendicular and is held in place against a stop which gives the same angle on either side of the perpendicular. The tilted head gives a concaved grind to the knives. A positive stop holds each knife in exactly the same relative position to the wheel; therefore, each knife must be ground true to the bed.

One of the illustrations shows the "Quicsharp" grinder attached to a Baxter D. Whitney & Son surfacer. When used on a surfacer, the angular brackets are reversed, the brackets being held in place by fixed pins located in the frame of the planer. These pins fit into holes in the foot of the bracket. Adjustments having once been made for each machine, it is only necessary when using the grinder to place it in position on the supporting pins.

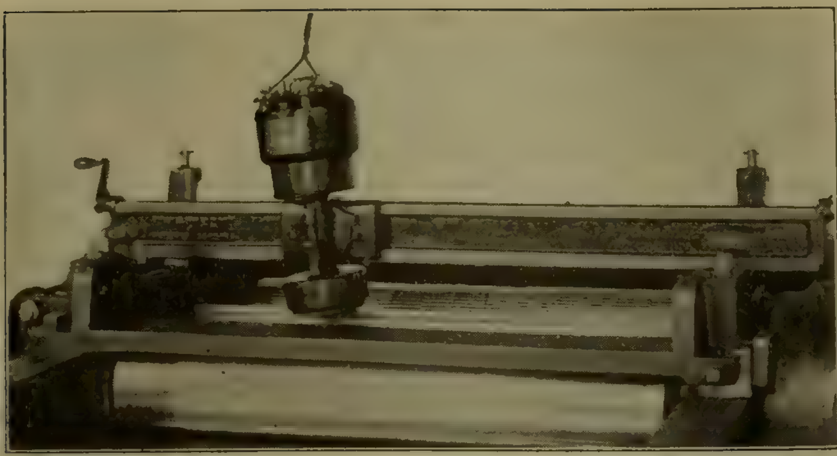
The following attachments can be furnished: Attachment for jointing knives while running; machine for setting the knives and back grinding; an attachment which grinds knives of curved or irregular shape, knives being ground exactly the same.

Among the advantages of this grinder are: A pair of knives once put on a machine are never taken off until worn out; harder knives can be used than is possible with the old method of whetting knives with a file and oil stone; the knives are always in perfect alignment with the bed and with each other, making each knife do its share of the cutting, thus insuring smooth and accurate work.

With cylindrical head planers, the knives are so thin and pliable that it is very difficult to grind them on an automatic



"Quicsharp" Grinder on Joiner.



"Quicsharp" Grinder on Surfacer.

and put them back on the machine in perfect alignment. A great deal of time is used up adjusting knives. With the "Quicsharp" grinder, these knives are ground to a razor-edge right on the machine in five to ten minutes, where it is usual for an operator to spend one-half to three-quarters of an hour, two or three times a day. With a "Quicsharp" grinder in the shop, there is no excuse for idle machines. If a nail or gravel stone is run into, usually, instead of having to take off the knives and adjust a new pair, a few minutes with the grinder will clean up the gap and work started again without any serious delay. Machines will take care of from 25 to 40 per cent more work than with the file and oil stone method. In the shop where the grinder was first used, four buzz planers are now doing the work with ease, that required five before its use, and with a reduction of one-half in the cost of knives. If one man takes charge of the grinding of knives, using grinder once a day, knives will be in better shape than the most expert operator could keep them.

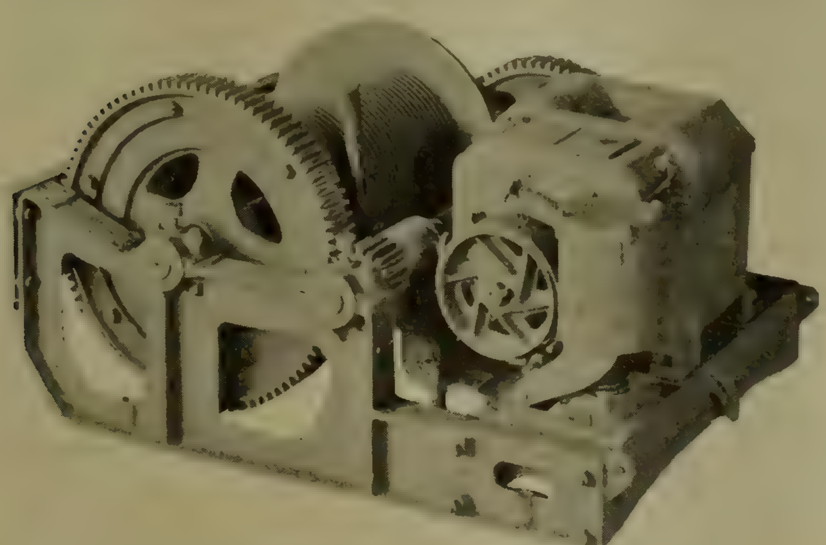
"Quicsharp" grinders are furnished by Baxter D. Whitney & Son on Whitney surfacers and are manufactured by the Stockbridge Machine Co., Worcester, Mass.

PORTABLE ELECTRIC DRAG.

The type of drag shown in the illustration is extremely useful and admirably suited for handling cars in freight sheds or repair shops, as a portable electric winch, as a stationary hoist for general contracting work and kindred service.

The frame consists of heavy cast steel sides securely connected by cast and structural steel cross pieces, forming a rigid unit. Bottom of frames are flush for skidding and provided with bosses for holding down bolts. Lugs are also provided for attachment to hauling links for moving the machine to different locations. The winding drum is of cast iron, machined with grooves to keep the hauling cable in place. The cable is of special plow steel rope, ¾" in diameter, 19 wires to the strand, 6 strands and a hemp core.

The drum pinion is free on the shaft and a jaw clutch is



Portable Electric Drag for Use as a Car-Puller.

provided thereon for coupling same to haft. The drum is, therefore, free to rotate when necessary to unwind the rope by pulling on it. The clutch may be left in engagement and motor controlled at proper speed to unwind rope as the end is carried away.

The motor is rated on a basis of 40° C. temperature rise after 30 minutes run with full load and is designed exclusively for crane and hoist service.

This drag is manufactured by the Shaw Electric Crane Co. and handled by Manning, Maxwell & Moore, New York.

REPAIR OF PRESSURE GAUGES.

The use of gauges on railway locomotives is practically as old as the use of locomotives themselves, and the testing, maintenance and upkeep of the various gauges used on a locomotive has come to be quite a business in itself. The testing department of every railway is frequently taxed beyond its capacity for repair work, and when this occurs it is necessary to fall back on the original maker for gauge repairs.

A consideration of the number of different gauges used and the number of makers of each variety of gauge has suggested to a student of economic maintenance the necessity of a central western expert gauge repair establishment, and the Bogardus Company of Chicago, Illinois, has taken up this work. Realizing that present conditions prohibit railways from carrying excess stocks of the different styles and sizes of pressure gauges necessary for their equipment, and that, therefore it is imperative that repair work on these gauges should be accomplished in the shortest space of time commensurate with skilled and accurate workmanship, and that a central location is desirable to facilitate delivery to and receipt from the repair station. This concern which manufacturers "Tre-foil" gauges has established a department to exclusively handle rush repair work for railways, which is equipped to handle the large volume of business which will naturally follow this departure.

Establishing itself some five years ago as a gauge "specialist" rather than manufacturer, the Borgardus Company has practically confined itself to the construction of "special" or "to order" gauges. This necessitates maintaining an efficient staff of skilled mechanics and carrying in stock at all times the essential working parts of practically every well known standard gauge.

The company is thus equipped for railway gauge repair work, regardless of the kind of gauge or the original make, as it has constructed high grade gauges made in the electric, steam, vacuum, air, hydraulic, ammonia, and other lines.

It has also done repair work for several of the big railways

Bogardus Standard Gauge ("Tre-foil").

whose satisfaction with the work and confidence in the house is shown by steady repetition of repair work orders. Such repair work has comprised furnishing new main springs, new movements, new dials, new rings, new glasses, etc., the mending of broken parts, and the careful re-assembling and testing of the gauges before return.

A few moments' reflection will prove to any thinking master mechanic or superintendent of motive power that, being able to centralize the repair of any gauges, is an efficient saving of time, trouble, and money.

LENNOX SERPENTINE SHEAR.

The Lennox serpentine shear, a new type of machine now being offered by Joseph T. Ryerson & Son, Chicago, Ill., is designed particularly for the straight and irregular cutting of sheets and plates.

The frame is a steel casting of spiral construction designed to provide sufficient clearance for material of unlimited length or width. This machine will handle not only straight cutting but also in or out curves having a minimum radius only slightly larger than the diameter of the blades. The spiral steel frame carries all gearing and is mounted on a substantial cast-iron base.

All gears have teeth cut from solid metal and are provided with cast-iron gear guards so the workman is fully protected while operating the machine.

The blades, which are made of high grade tool steel, are set in approximately a horizontal plane. This gives a very large cutter bearing on the sheet or plate and consequently there is very little distortion in the cutting. The upper cutter is positively driven, while the lower cutter is mounted in an adjustable sleeve, so that its position may be varied to allow for different thicknesses of material and for redressing. In addition to this, a cam is provided so that the lower blade can be dropped enough to permit the removal of sheets without reversing the machine. The cutters have a flush fastening to the shaft so that no nut projects to interfere with the handling of the work and the knurled edges feed the sheet automatically into the machine. A tool-steel pin is provided to take up the end thrust on the lower cutter shaft.

Lennox Serpentine Shear.

Where a number of sheets are to be cut to the same pattern, a template may be bolted to the work and this template followed by guiding against the top cutter.

The machine is driven by means of a two speed pulley, giving slow speed for intricate curve cutting and high speed for straight work. The main drive shaft is extended and squared on one end so that a hand crank may be used if power is not available.

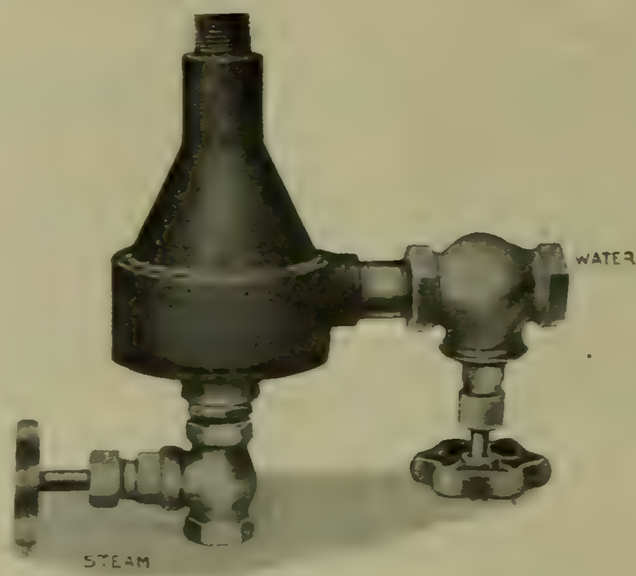
This shear will reduce cutting costs fully one-half by replacing old style hand and power cutters and thus saving time and labor in handling.

The shear illustrated has a capacity for cutting No. 10 gauge material and lighter, while other sizes having capacities of No. 16 gauge, ¼ inch and ⅜ inch material, can be furnished. All machines are arranged for either belt and hand power or direct motor drive.

EFFICIENT STEAM-WATER HEATER.

The illustration shows a device for the purpose of heating water by steam in contact, manufactured by the Warner-Reiss Sales Co., Frisco Bldg., St. Louis, Mo. It is called the Starwal heater.

The quickest and most economical manner of heating water is by steam in contact, but this method is troublesome under



Steam-Water Combiner.

ordinary circumstances, and frequently separate coil or storage equipment is required.

The heater consists of a conical outer shell 5½"x9½", inside of which is a perforated cone, both of cast iron. The water enters the outer shell through a 1¼" opening and forms a thin wall of water around the perforated cone. The steam enters the cone through a similar opening and is sprayed into this water, heating it instantaneously to any desired temperature, dependent upon the volume of steam admitted. The discharge is through a 1¼" opening. This device is said to render such additional facilities unnecessary as it combines steam and water without difficulty. The applications for the device about roundhouses, shops, and terminals should be many.

ASBESTOS CAR LINING.

The Franklin Mfg. Co., Franklin, Pa., has developed a very efficient insulating material for steel passenger and postal cars. This insulation is manufactured wholly of pure asbestos. It is made in sheets 3 ft. by 6 ft., or smaller, and in thicknesses of ⅛ in. to ½ in.

One of the features of this car lining is that it will not disintegrate or jar off the sides of cars. It is fireproof and an excellent non-conductor. In application, ordinary car paint to which is added a small amount of iron oxide, is used.

The material has passed, with credit, many tests of stringent nature and it is expected that it will be found satisfactory in all steel car lining applications.

New Literature

The Mesta Machine Co., Pittsburgh, Pa., has issued Bulletin "M," entitled "Mesta Improved Pickling Machines." Pickling means the removal of scale and other substances from the surface of metals by the chemical action of acid. The machines described are adapted for pickling objects of any shape and are made in many sizes.

* * *

The Terry Steam Turbine Co. has published a description of its return flow steam turbine in Bulletin 17. This turbine combines velocity staging and pressure staging. The steam after expanding in the high-pressure element from boiler pressure to a pressure slightly above the atmosphere, flows through the passage to the opposite end of the turbine; whence in returning through the low-pressure element towards the high-pressure end, it is further expanded to condenser vacuum. It is this feature that gives the turbine its name.

* * *

The National Tube Co., Pittsburgh, Pa., has compiled a list of "National" products and published it in bulletin form for quick and ready reference.

* * *

The Westinghouse Electric & Mfg. Co. has published an interesting booklet entitled "The Power of a Name." It contains reproductions of full page advertisements which have recently appeared in The Saturday Evening Post and a number of other popular journals. A catalogue section on catenary line material has also been sent out by this firm.

* * *

The Northern Engineering Works, Detroit, has issued a new crane catalog, No. 26, illustrating the electric traveling cranes, hand-power traveling cranes, electric and pneumatic hoists, which they manufacture. Their overhead track systems, bucket handling cranes and railway cranes are also shown. This is a condensed catalog but contains references to various bulletins which more fully explain the numerous designs.

The Selling Side

The Safety First Manufacturing Co. has been organized with offices in the Railway Exchange building, Chicago. It will handle various high-class railway specialties, besides taking over the business of the E. D. E. Company, of which the late Frank M. Gilmore was president.

The Armspear Manufacturing Co., 447 West Fifty-third street, New York, will be represented in southern territory after March 1 by E. H. Pilson, with offices at 907 Woodward building, Washington, D. C.

Samuel N. Pond and Ira J. Wilson, the former having been associated with the firm of Offield Towle, Graves & Offield, and the latter having been associated with Linthicum, Belt & Fuller, have formed a partnership for the practice of patent and trademark law. The new firm is known as Pond & Wilson and has taken offices in the Monadnock building, Chicago. Both Mr. Wilson and Mr. Pond have had long experience in patent law and their success is assured.

The Acme Supply Co., Steger building, Chicago, announces the appointment of Stanley W. Midgley as general sales manager.

Mr. Midgley is the eldest son of J. W. Midgley, who was for over twenty years the commissioner of the Western Freight Association, which comprised the several railroads that extended westwardly from Chicago and St. Louis. He has been in the railway supply business for the last twelve years, beginning with the National Car Coupler Company as general sales representative, and for the past six years he has been with the Curtain Supply Company as western representative and western sales manager, until his appointment to the present position.

Stanley W. Midgley.

D. R. Niederlander has been elected president and treasurer of the Adreon Manufacturing Co., of St. Louis, Mo., succeeding the late E. L. Adreon, Jr. Mr. Niederlander has been in the railway supply business for the past twelve years, having organized the Inland Equipment Co. in 1901. This company was consolidated in 1903 with the railway supply interests of E. L. Adreon, Jr., in the formation of Adreon & Co., afterwards the Adreon Manufacturing Co. The latter firm controls valuable patents on railway supply devices in both the mechanical and engineering departments of railways, and also represents in the Southwest prominent manufacturers of railway materials.

D. R. Niederlander.

After long litigation the American Roll Gold Leaf Co., Providence, R. I., has been awarded a decision against the W. H. Coe Mfg. Co., in its appeal of an infringement decision previously rendered and favoring the latter concern. The suit was brought by the W. H. Coe Mfg. Co., claiming infringement. The defense of the American Roll Gold Leaf Co. was non-infringement.

GEO. P. NICHOLS & BRO., Chicago, have recently received an order for nine electric turntable tractors from the Cleveland, Cincinnati, Chicago & St. Louis. This is said to be the largest single order for turntable tractors yet placed. The management of the road, having ascertained the saving affected by the Nichols tractor, made an investigation to determine at what points tractors could be used and placed this order to supply all these points.

WILLIAM D. MAINWARING, who has been connected with the Detroit plant of the Railway Steel Spring Co., has opened a consulting business as production engineer, with offices at 866 Rockefeller building, Cleveland, Ohio.

H. F. WARDWELL has been appointed Chicago representative of the Monarch Steel Castings Co., of Detroit, with office at 359 Railway Exchange.

JOHN L. RANDOLPH has been appointed eastern sales manager of the Economy Devices Corporation, 30 Church street, New York.

THE W. J. BAKER NUT & BOLT LOCK WASHER Co., Newport, Ky., has succeeded the Universal Nut & Bolt Lock Co.

F. W. DAVIS, JR., vice-president of the Detroit Graphite Company, Detroit, Mich., has been elected president of that company, succeeding the late A. A. Boutell, with office at New York.

T. R. WYLES, second vice-president, has been elected vice-president of the Detroit Graphite Co., succeeding Mr. Davis.

FRANK GREGG, for many years with Adams & Westlake, has made a connection with the Rostand Mfg. Co., of Milford, Conn., and is opening an office at Richmond, Va., from which point he will cover the Southern territory in the interests of that company.

THE EDGAR STEEL SEAL & MFG. Co. has received a contract from the Great Northern for its car seal supply for the next five years.

THE WESTINGHOUSE ELECTRIC & MFG. Co. has moved its New Haven, Conn., office from the Woods building to the Chamber of Commerce building at 185 Church street.

THE INTERSTATE CAR Co., Chicago, has been incorporated with a capital of $100,000; to manufacture, build, and deal in railway supplies, equipment, etc. The incorporators are: C. E. Fitch, Chester S. Holzman, Conrad M. Bentley, Joseph Holzman and David L. Bleloch.

THE NORTHERN INSULATING Co., St. Paul, Minn., has received orders for Flaxlinum insulation for 150 Illinois Central refrigerator cars and 50 dining cars for the Atchison, Topeka & Santa Fe.

H. E. GIFFORD, general sales manager of the National Electric Specialty Company, has recently been appointed sales agent for the Handy die stock and the Becker receding pipe threader.

W. F. BAUER has severed his connection with the United States Light & Heating Co. to accept the position of assistant manager of the railway department of the Edison Storage Battery Co., Orange, N. J. From 1903 to 1905 Mr. Bauer was chief electrician of the Missouri Pacific at St. Louis. Later he became sales engineer for the Electric Storage Battery Co., Chicago, and in 1907 he took a similar position with the National Battery Co. Soon after he became manager of the United States Light & Heating Co.'s railway department in Chicago. Mr. Bauer will continue to make his headquarters in Chicago.

O. P. WILSON has resigned his position in the purchasing department of the Westinghouse Electric & Manufacturing Co. to accept the position of assistant general manager of the Norma Company of America, 20-24 Vesey street, New York City, manufacturers and importers of ball bearings, roller bearings, precision instruments, etc.

CHARLES A. CARSCADIN has been elected president of the National Car Equipment Co., with offices in the Railway Exchange building, Chicago. George A. Woodman, formerly of the Kirby Equipment Co., is general manager of the company.

C. W. OWSTON has been appointed to the railway appliance sales department of McCord Mfg. Co., Detroit, Mich.

SCOTT R. HAYES has been appointed assistant to the president of the New York Air Brake Co. Mr. Hayes has been with the Railway Steel-Spring Co., New York, since its organization, and resigns to go to the New York Air Brake Co.

THE UNION DRAFT GEAR Co. has made the following changes in its staff: W. G. Krauser, formerly mechanical engineer, has been promoted to assistant to vice-president. James E. Tarelton, formerly assistant mechanical engineer, has been promoted to assistant to vice-president. K. Barnard, formerly chief draftsman, has been made mechanical engineer.

EDWARD W. HODGKINS, formerly with Guilford S. Woods, Chicago, has gone into business for himself.

CHARLES I. WEBB has been elected vice-president of the International Seal & Lock Co., of Chicago.

The Chicago offices of the OKADEE COMPANY have been moved to the Lytton building, Jackson boulevard and State street.

THE INDEPENDENT PNEUMATIC TOOL Co. of Chicago has announced the following appointments of district managers, effective March 1: R. T. Scott, manager of the Pittsburgh district, with office at 1208 Farmers' Bank building, Pittsburgh, Pa.; F. H. Charbono, manager of the Southern district, with office at 1629 Chandler building, Atlanta, Ga.

THE DUFF MANUFACTURING Co., Pittsburgh, Pa., has opened an office in the Peoples Gas Building, Chicago. This company has recently appointed G. W. Parsons, district sales agent, with offices in the Pioneer Building at St. Paul, Minn. The company also announces that by mutual agreement the Fairbanks Morse Company has discontinued acting as exclusive steam railway agents for the Duff jacks.

A. C. ADAMS, who recently resigned as superintendent of motive power of the Spokane, Portland & Seattle, has been made the Pacific coast general agent of the General Brake Shoe & Supply Company, Chicago. He will have headquarters at 907 Wilcox building, Portland, Ore.

THE CHICAGO CAR HEATING COMPANY has recently opened a branch office and factory at 61 Dalhousie street, Montreal, to take care of its business in Canada. A. D. Bruce, of Guelph, Ontario, formerly the purchasing agent of the company at Chicago, has been placed in charge.

JOHN F. SCHURCH has been elected vice-president of the Damascus Break Beam Co., Cleveland, Ohio.

THE WHITING FOUNDRY EQUIPMENT COMPANY, Harvey, Ill., has arranged with S. R. Vanderbeck, 217 Walnut street, Philadelphia, Pa., to handle the company's complete line in Philadelphia territory.

KARL A. HEINE has joined the sales department of the Chicago Car Heating Company, Chicago, and will be connected with the New York office at the Grand Central Terminal.

J. T. WILSON, president of the American Balance Valve Co., Jersey Shore, Pa., has left for a three months' trip to the Pacific Coast.

OBITUARY.

WILLIAM H. BOARDMAN, for many years president of the *Railway Age Gazette,* died on February 16 at his home at Ridgefield, Conn. He was 68 years of age.

EDWIN M. HALL, treasurer of the Jefferson Union Co. Lexington, Mass., died on Wednesday, February 11.

POSITIONS AND AGENCIES.

AGENCY WANTED: Firm having warehouse and shipping facilities would like to handle the St. Louis agency for a good live line, preferably paints or varnishes, or a good specialty, and calling on the railroad trade in particular. Address A. S. L., care The Railway List Co., 431 So. Dearborn St., Chicago.

POSITION WANTED: Salesman with 12 years' experience in selling supplies and equipment desires to represent an established concern dealing in either mechanical or engineering supplies or both. Can furnish the very best of references as to ability, integrity and record of sales. Address H. A. C., care The Railway List Co., 431 So. Dearborn St., Chicago.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

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In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, April, 1914 No. 4

CONTENTS.

George Westinghouse

Of all the honorary titles conferred upon the late George Westinghouse, none was more full of meaning than that of "Engineer." America has many distinguished engineers, but as a constructor and inventor Mr. Westinghouse stood alone. He has left companies bearing his name which are capitalized at $200,000,000 and give employment to 50,000 people, but all this is only a fraction of his contribution to civilization, which it seems has touched nearly every branch of engineering activity. In the sketch of his life and activities, published elsewhere, one cannot help being amazed at what he was able to accomplish in sixty-eight short years. Possibly one of the secrets of his work was that his mind was unceasingly active; that he was always interested in all which came under his observation. A collision between two freight trains suggested to him the need of having the brakes under control of the engine driver. An article in a magazine told him of the use of compressed air and the result was that his active mind finally evolved the air brake. When one problem had been solved he immediately sought other problems to solve and his mind continued active until his death. What most men have given to posterity seems very small compared to what George Westinghouse has given.

Encourage the General Foreman

The General Foremen's Association, through its secretary, William Hall, Winona, Minn., has sent a number of letters to superintendents of motive power, urging that they encourage their general foremen to attend the annual convention to be held at Chicago, July 14 to 17. Among other things these letters state that "if the time spent at the convention would not be deducted from their annual vacation our membership would have been increased fifty per cent. A large number of general foremen would like to become members but they do not feel that in addition to defraying their own expenses the time should be deducted from their vacations."

As we have said in these columns previously the General Foremen's Association has a wide field and a thorough discussion of shop problems by such an organization gives the members valuable information which they themselves can put directly into practice when they get home. The general foreman is in the shop, on the job, and he can do much towards lowering the cost of production. It is of course not always possible to allow the foremen time, but those at the head of mechanical departments should give these men all the encouragement they can to attend these conventions.

Individual Motor Drive for Machine Tools

For years the manufacturers of heavy machine tools, such as are used in the machine bays of railway erecting shops, have been advocating the use of individual motor drive. Greater efficiency for their machines is the object in view and this is obtained by the fact that the machine tool may be operated to a maximum capacity while at the same time its movements are directed with greater facility.

The master mechanic or shop superintendent is not, however, so much interested in the efficiency of any individual unit as he is in the efficiency of the department or the repair

shop as a whole. From the entirely mechanical, line shaft and belt, drive of a few years ago we have passed through the stage of partial electrical or large group drive to a period of almost universal electrical drive. This, however, is true only of the newly laid out shops. Shops which have been in service for years are not arranged, so far as their machine tools are concerned, in such a way as to make complete individual electrical drive feasible. Machine tools as built years ago are not always easily adapted to individual motor drive, especially when located in crowded quarters. It is always possible, however, to arrange groups to be driven from motors in such a way as to have in each group only machines which are practically all to operate simultaneously. It is nearly as inefficient to operate only one machine in a large group as it is a few scattered machines throughout a shop which is entirely mechanically driven.

The losses and inefficiencies of the mechanically driven shop and to a lesser extent of the shop in which the machinery is divided into large groups, are particularly flagrant under conditions of retrenchment and light work, or under conditions which drive the shop to over-capacity. The intermediate condition, that is, the period during which the shop is working evenly and regularly to full capacity, does not show up mechanical and large group drives in their poorest light. This is due to the fact that in times of retrenchment only a part of the shop forces are engaged and for only short hours. At such times many of the machines, and sometimes the majority of the machines, are standing idle and, of course, the proportionate friction losses of line shaft bearings amount to a high figure, whereas the machines which are in operation can be operated by individual motors at practically the same power expense per machine as when the shop is running to capacity.

Under the conditions which allow of the even full capacity operation of all machinery, line shaft bearing friction losses are divided proportionately among all machines, and it is at this time that the mechanical drive, as mentioned above, is least inefficient. In the period of a rush of repair work we have conditions at certain times of the day closely approaching those resulting from short time work. This is due to the fact that over-production of one department and under-production of another will result in the necessity of a great deal of overtime, which in turn calls for the operation nights and Sundays of a few machines scattered through the shop, and again individual motor drive prevents heavy power loss.

It would seem, therefore, that there is no argument against the lay-out of a new shop for individual drive throughout except where machinery is so light that the cost of individual motors would be very excessive, and it would seem also that during the present period of dullness in repair shop work that the necessity for rearrangement of machinery in old shops to reduce to a minimum the amount of line shafting would be an object towards which mechanical officers should work.

It is seldom impossible to equip the heavier machines with their own motors, even in the most crowded bay, and a study of almost any inefficiently mechanically driven shop is sure to show chance for improvement in this direction. Groups can be split up in such a way that only machines which are to operate simultaneously are driven by a single motor, and the expense of installing such motors, together with the rearrangement work, would not be found excessive when compared with the power losses and inconvenience of old methods, except where the power plant itself is not equipped with the necessary generating machinery, and such cases are few and far between, indeed in most cases this individualization will reduce rather than increase the current which the engine room is called upon to deliver.

Making Mechanics

Is there a scarcity of good mechanics in this country? Are we giving enough attention to the training of men to fill positions in our shops? These are some of the questions which have been raised of late years by those interested in shop operation. Many are of the opinion that there is a scarcity of good mechanics and if this is so, then the opportunity for men to become proficient in shop work must be lacking on many roads. Turning men into mechanics is a matter of production; if there is plenty of raw material entering your shop and but little of the finished product being turned out, something is wrong with the manufacturing end of your factory. If good mechanics are not plentiful, something is wrong with the efforts made to produce them.

Good mechanics are well paid, their work is steady and the chance for advancement is as good as in other trades. The average boy, and the average man for that matter, will take the path of least resistance, however, and if no inducement is held out to him, he will enter that line of activity which appears at least to offer him some advantages.

Many railroads have made no efforts to handle apprentices in their shops and others have paid but scant attention to the apprentices after once starting them in. It is time for these roads to wake up. There are some excellent apprentice systems on various railways of this country and it is a significant fact that the roads maintaining such systems are noted for the strength of their organizations.

It is our purpose to run a number of articles on apprenticeship systems and we present in this issue an article by F. W. Thomas, supervisor of apprentices on the Santa Fe system, which outlines the work being done on that road. That the system in use on these lines is a comprehensive one is indicated by the fact that there are at present twenty shop instructors, nine school instructors and seven joint shop and school instructors devoting their efforts to the training of eight hundred apprentice boys. The complaint is sometimes made regarding apprentice systems that the boys do not stay with the road after completing the course and that some other line gets the benefit of their training. Wherever this is the case, we firmly believe that something is wrong with the system. One of the striking statements of Mr. Thomas' article is that after having had the present system of training apprentices in operation for over six years, 70 per cent of all the graduates are still in service. The reason for this is that the apprentices are made to feel that they are entering an institution; that the road is offering to them a definite training which will fit them for a definite field. They know that the officials of the road are watching them and are interested in them. The fact that some of the boys are dropped during the first six months also helps to make the boys feel that the course is something worth while. The management has shown its wisdom in encouraging the

formation of baseball clubs, bands and other organizations, for bringing the boys together as "Santa Fe boys" when work is for the time being forgotten. This is of inestimable value in promoting loyalty and making the boys contended. When the boys have worked together and played together for four years, it is not surprising that a big majority of them stick to the Santa Fe. It is work of this sort which builds up a competent and loyal organization.

There are schools which boys can attend and learn to be bookkeepers, lawyers, stenographers, doctors and what-not, but a boy cannot go to a school and learn to be a competent mechanic, a foreman or shop superintendent, before ever going into a shop. Therefore the boys who wish to become competent shop men in most cases have had to enter a shop and dig out the knowledge necessary to an intelligent understanding of their work, as best they could. It is not to be wondered at that they often took what appeared to be an easier and more profitable field.

The railways, as the second largest industry in the country, must make their own mechanics; must offer opportunity to those who wish to enter their shops, if they want their shops filled with the best mechanics in the future. A good apprentice system is a sound foundation for the mechanical department of any road.

CORRESPONDENCE.

Editor *Railway Master Mechanic*—

In the January issue you illustrated on page 15 a pop-valve that caused an explosion. Will you kindly describe just how this was arrived at? What bent the adjusting screw in that manner? Also kindly explain what the other two pop-valves were doing to allow the explosion to occur. The paper is certainly a very interesting one and would be still more so if full particulars of this pop-valve incident were described.

M. I. K.

[A copy of the above communication was forwarded to the author of the paper and his reply follows.—Editor.]

Editor *Railway Master Mechanic*—

In reply to the above will say that the other two pop-valves were in exactly the same condition as the one shown. Attention was directed at the meeting to the condition of the adjusting screw, which had the corners twisted off and marks of a Stillson wrench on it, showing very plainly evidence of abuse. Views of two of these safety valves were shown at the meeting, but as they were almost identical it was probably thought unnecessary to publish both.

FRANK MCMANAMY,

Chief Inspector Division of Locomotive Boiler Inspection, Interstate Commerce Commission.

THE SAFETY COMMITTEES of the Grand Trunk are doing most effective work in the prevention of personal injuries, as is clearly shown by a statement just issued by George Bradshaw, safety engineer of that system. From September, 1913, to February, 1914, inclusive, there was a decrease of 46 per cent in the number of employes killed and a decrease of 16 per cent in the number injured, including all classes of injury, serious or trivial, as compared with the corresponding months of 1912 and 1913. The safety movement was put into effect on the Grand Trunk in August, 1913.

The Northwestern Pacific will build a roundhouse and shops at San Rafael, Cal. The road has been granted permission to float a $5,000,000 bond issue.

ENGLAND LOSING BIG RAILWAY CONTRACTS.

The order for ten locomotives just placed in Germany by the South-Eastern and Chatham Railway of England raises some very important issues. Great damage is declared to have been inflicted recently on the British engineering industry as the result of orders for locomotives, rolling stock, and general equipment for Colonial railways and English-owned lines in South America being given to Continental and American manufacturers. Quite recently there has also been a tendency for British railways to order their equipment abroad. In regard to electrical plants, this is understandable enough, since there does not exist in the United Kingdom, a single electrical works which could handle the whole of a large electrification contract without recourse to a foreign factory, but it is not confined to electrical plant. Locomotive orders have also been sent out of the country.

It will be of interest to give some actual particulars of contracts recently awarded to foreign engineering concerns. The following table, which is by no means complete, refers only to orders for locomotives placed within the past eighteen months:

Name of Railway.	No. of Locomotives.	Country to which order went.
Buenos Aires Pacific	20	Germany
Buenos Aires Great Southern	10	Germany
Antofagasta (Chile & Bolivia)	10	Germany
Egyptian State	5	Germany
Egyptian State	5	Belgium
Egyptian State	5	Germany
South Indian	16	Germany
Cordoba Central	5	Germany
Nigerian Government	8	United States
Assam-Bengal (Gov. Railway)	10	Germany
South Indian	4	Switzerland
South African (Government)	10	Germany
Antofagasta	8	Germany
South Indian	3	Germany
Cordoba Central	28	Germany
South-Eastern & Chatham	10	Germany

The above orders represent a total of 157 locomotives. The mean value of each locomotive may be placed at between $17,500 and $20,000 (the locomotives ordered for the South African Government Railways cost considerably more), but it will probably be understating the figure to assess the average value at $18,750 apiece. This gives a total cost of $2,943,750, and if that be placed approximately at $3,000,000, it can be regarded as a conservative estimate. This is not only a big loss to shareholders of British engineering firms, but a very great loss to British labor. The locomotive is pre-eminently one of those manufactured articles, in making which the cost of labor is a far more important item than that of material. Labor may, in fact, be responsible for as much as 75 per cent of the cost of turning out the finished product. But if we take it as 66⅔ per cent to be on the safe side—and this is the lowest possible estimate—it will be seen that the above orders alone represent a loss of $2,000,000 on wages to the British working man. And it is important to note that it is to a large extent the very highest class of skilled labor that is affected.

In fairness it should be pointed out that when a contract of the kind is given to a foreign maker there is sometimes a stipulation to the effect that certain materials shall be of British origin. For instances, there may be a proviso for the use of Yorkshire iron. But at best this represents no more than about 25 per cent of the raw material used, or about a twelfth of the cost of the finished product. And the stipulation is not made in every contract.

The assistant general manager of the South-Eastern and Chatham Railway, G. B. Hayne, has stated the considerations which led them, for the first time since their establishment, to go abroad for rolling stock. To meet immediate requirements 15 four-wheeled coupled bogie locomotives had been obtained

on loan from the Great Northern Railway, and the object in acquiring the additional engines being to meet the summer business, and especially that of the Continental and boat express traffic. The decision of the directors was not due to a question of price, but entirely to one of delivery. The British locomotive and rolling stock firms were so full up at present that they could not undertake to let the company have the engines for many months so they had to look about outside to see whether they could secure them within a reasonable time. The German company had undertaken to build and supply the engines by the time they were wanted, and the railway company would not have gone outside the country at all if this need could have been met at home. No British firm would undertake to deliver them by the end of May as required. And it was not either a question of the German firm being able to build them better; quickness was the sole deciding consideration. British firms were so full up with work that they could not take any more. The engines would be of the same type as if they had been built in England.

THE M. C. B. BILLING DEPARTMENT.

By Herbert Corkran, Billing Instructor, Atlantic Coast Line.

The M. C. B. billing department of most of the large railroads is not given the proper attention it should have by the head of the car department.

The car department is usually well organized with the exception of the billing department, which is often supplied with clerks from various other departments.

The essential way to organize the M. C. B. billing department, in order to obtain the best results and save the company thousands of dollars each year, is as follows:

An assistant to the head of the department, who is a practical car man and is thoroughly conversant with the M. C. B. code of rules, with interchange work, piece work, and who knows how to deal with organized labor.

A billing instructor, who will instruct the car clerks how to write the repair cards and check to see that repair cards are made for all work done to foreign cars.

A chief bill clerk to handle the work in the office and with as many assistants as necessary. By using the billing machines with the adding attachments, on large roads where the work is heavy, a saving can be made of two clerks. All the clerks in the billing department should be practical car men with the exception of the billing machine operators.

The assistant to the head of the department with the assistance of the billing instructor should train men at the car shops so they could be promoted to the office in case of vacancies, thus keeping a practical man on the job and promoting from the ranks.

By having the billing department organized as above you can catch and stop the many leaks that would be overlooked by impractical men and put into the company's treasury thousands of dollars each year.

I have made a personal study of the M. C. B. billing department and to bear out my argument that it should be well organized with practical men, I will cite a few cases of comparison that I have made recently.

Two repair cards called for the same work, namely, one draft timber 4 ft. 8 inches long and eight 1⅛"x20" draft bolts at "A" end. On one card simply showing this information and charge versus owners for material and seven hours labor, the billing clerk arrived at the labor from M. C. B. rule 107, which allows seven hours for one short draft timber and bolts to apply same. The other card read as follows: one draft timber 4 ft. 8 inches long and eight 1⅛"x20" draft bolts at "A" end; four draft bolts in old timber and owner's charge for material and nine hours labor, seven hours for one draft timber and bolts to apply same and two hours for the four draft bolts in the old draft timber. The difference in the two cards was two hours at 28c an hour, which equals 56c.

Two cards were made out as follows: one release valve rod applied account missing, the card price being 10c; the other card read, one release valve rod applied account missing and one cotter key, card price 16c, making a difference in the two cards of 6c. M. C. B. rule 59 makes a missing release valve rod an owner's defect. On the first card the maker failed to show the cotter key and the billing clerk priced same referring to M. C. B. rule 101, which allows 10c for a missing release valve rod, and priced the card accordingly. On the second card the maker did not omit the cotter key, as no doubt he had been instructed that every time a cotter key was applied to a foreign car and he failed to show same on the repair card, his company lost 3c. The man pricing same, being a practical man and knowing there should be a labor charge for this operation, referred to M. C. B. rule 111, which allows 3c for applying a release valve rod.

Two cards reading as follows: one new knuckle pin at "B" end and card price 20c; the other card reading, one new knuckle pin and cotter key at "B" end and priced 23c, a difference of 3c in the two cards.

Two cards reading as follows: one brake shaft applied at "A" end account of broken and charge versus car owner for labor and material; the other card reading one brake shaft and cotter key applied at "A" end account broken and charge versus owner for labor and material, plus 3c for cotter key, a difference of 3c in the two cards.

Referring to the last two cards, it is a U. S. Safety Appliance requirement that cotter keys be applied to knuckle pins and brake shafts. Undoubtedly they were applied in the above mentioned cases and the man writing the repair cards failed to show the cotter keys and the billing clerk also failed to detect these errors.

I have compared a good many cards showing siding and sheathing applied, and will say that 25 per cent of the cards failed to show any paint and nails used in making the repairs. Had the cards shown these items, they could have been billed versus car owners, as follows: paint 6c per lb. and nails 3c per lb.

I have also noted in these comparisons that a good many cards show running boards repaired or refastened with nails. The first paragraph in rule 52 reads as follows: "running boards in bad order or insecurely fastened; bolts, rivets or screws to be used on parts repaired."

Therefore, when a road makes repairs to a running board and uses nails, it simply uses its own material, paying the repair men for the work, and cannot be reimbursed by the car owner for same because the repairs are not M. C. B. standard.

In the above cases there is a lot of room for the assistant to the head of the car department and the billing instructor to do some missionary work instructing the men on the repair track how to make repairs in accordance with the M. C. B. rules; also in instructing the car clerks how to write the repair cards, in order that their company will be reimbursed for all labor and material expended according to the prices set forth in the M. C. B. code of rules.

The above are a few examples of the many cases which are termed a leakage and can be stopped by giving the proper attention to the M. C. B. billing department, and having it well organized.

THE CHICAGO GREAT WESTERN traffic department has issued a circular on answering telephone calls, stating that it is desirable to have a uniform method of answering calls and asking that they be replied to as follows: "Great Western, Smith talking," with an upward inflection at the end. The circular states, and undoubtedly it is a fact, that it will not only tend to increase efficiency but will increase the reputation of the company for courtesy.

JOHN R. THOMPSON has resigned as master mechanic of the Chicago Great Western, to take the position of senior mechanical engineer of the central district, Interstate Commerce Commission valuation board. His headquarters are at Chicago.

Making Mechanics on the Santa Fe

By F. W. Thomas, Supervisor of Apprentices, Santa Fe Railway System, Topeka, Kansas.

The writer has read the article in the January issue of the *Railway Master Mechanic* under the caption of Apprentice Efficiency, by John Hewitt. While agreeing with him that there has been a growing scarcity of good mechanics in the country, we do not agree with him that there does not seem to be any more system in training apprentices than when he was a boy. He evidently does not read the railway publications regularly or else he would have been familiar with the present advanced system of training and educating apprentices in vogue on the New York Central Lines, the Erie, Pennsylvania, Canadian Pacific, Southern Pacific, Santa Fe, and other roads. Each of the above mentioned roads has a regular system for educating and training boys who enter their shops as apprentices, and the Santa Fe, we think, has the most complete system in the country.

One of the New Schoolrooms for Apprentices on the Santa Fe.

At the present time there are nine school instructors twenty shop instructors, and seven joint shop and school instructors engaged in educating and training the 800 apprentice boys on the Santa Fe, and for the benefit of Mr. Hewitt and other readers of the *Railway Master Mechanic* I am glad of the opportunity of describing our apprentice system.

The Santa Fe apprentice system is composed of two coordinate branches, one known as school instruction, and the other as shop instruction. The men engaged at the smaller points having from twelve to fifteen apprentices, and who have charge of both school and shop work, are known as joint instructors. At the still smaller points, having from five to eight apprentices, we have a traveling instructor who visits two or more places each week, spending two days at each point.

SCHOOL INSTRUCTION.

At each mechanical point on the system we have a room in the midst of the shop buildings, but sufficiently removed to be free of objectionable noises of the shop, this room being known as the apprentice school room. As its name suggests it is equipped with the necessary furniture, such as desks, tables, chairs, cabinets, models, drawing instruments, etc., all being provided free by the company for the use of the apprentices. The man in charge of this room is known as the apprentice school instructor. He must be a man both theoretically and practically educated. In fact, practically all the school instructors are men who have been graduated from some technical college or university and who served an apprenticeship on this road and are, therefore, familiar with the theoretical and practical operation of each device or part of locomotive, car, or shop tool.

The subjects taught in the school room are mechanical and free-hand drawing, sketching, shop arithmetic, the simpler elements of mechanics and business letter writing. A little treatise on the trade they are learning and the material used in such trade is also provided for their information. No regular text books are used, but lesson sheets (see illustrations) with practical problems, such as they daily come in contact with in their trade, are given them. Each lesson contains some part of the shop tools, locomotive or car, the object being to keep the boy's mind fixed on the trade he is indentured to learn and not allow his mind to wander in foreign fields. As stated, these lesson sheets are simple and practical and are kept up to date, for having a printer and press of our own we are at liberty to change these lesson sheets at any time we see fit.

The apprentices are required to attend the apprentice school two hours a day for two days a week during daylight or working hours. It is needless to say that it does not require very much "making," as our apprentices are always more than anxious for the hours to arrive at which they can go into the school room. Each apprentice has his own drawing board, a full set of first-class drawing instruments, scales, triangles, etc., and a regular place is provided in lockers for these, all of which is furnished free by the company and the boy is paid while attending school. The school hours are generally from 7:00 a. m. to 9:00 a. m., when the boy is fresh from

his night's rest. Better results are obtained at this time than any other part of the day.

While night school may have been profitable years ago it was before this nervous, distracting age. A boy working in a modern railroad shop for ten hours is practically unfit for night work or study. There is so much to attract him these days that we believe that the evening hours should be left to him for his own amusement and recreation. While the brightest and most energetic and ambitious boy would probably make the best of a night school, we do not always have these boys. It is the average boy with whom we must deal, and we must make our requirements suit his condition. Six years of day schooling with two or three years of night work in our apprentice work has proven the truthfulness of the above asertion.

SHOP INSTRUCTION.

In the shops where the real practical work must be learned we have found that in any of our modern shops where the officers of the shop are vitally concerned in the output of the shop, the foreman and gang foreman have very little, if any, time to devote to the apprentices and so for every twenty-five boys or less, and for each department, we have employed a man known as the shop instructor, whose sole duties are to teach and instruct the apprentice while learning his trade. He is not responsible for the output of the shop or the output of any machine, but he is there solely for the purpose of seeing that the apprentice learns quickly and is taught the most improved and modern method for each operation. He takes the boy in hand, starts him out on some small simple machine, first showing him the different parts of the machine, how it is controlled or operated, how to avoid certain things in order that his fingers, arms, or body may never be endangered, also to be on the lookout at all times for the safety of his fellow workmen. He is moved from machine to machine, from one class of work to another class of work (machine to the floor, floor to bench, etc.), just as soon as he masters each step. There is no set program for moving or changing the boys around. Where some boy can master a lathe in 60 days, another can get away with it in 30 days. It may require him 90 days to master the milling machine, while another will require six months. It is left entirely with the shop instructor to say when the boy shall be transferred from one class of work to another, but the shop instructor is held solely responsible for the thorough instruction of the boy and he must be given every class of work in his particular shop during the four years apprenticeship.

Each boy is provided with a first-class set of tools used in his particular trade. These tools are purchased at wholesale price and sold to the apprentice on small monthly payments, each apprentice thereby being provided with a uniform set of tools of first-class quality, and these are replaced free

Apprentices and Instructors at a Mountain Division Shop.

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39. (a) Add three hundred six million, four hundred thirty-four thousand, sixty-three thousand, and five million five thousand five. (b) From three million three thousand three, subtract one million six hundred seventy-eight thousand nine.

40. If it takes 54 screws to weigh one pound, how many cases each requiring 27 screws can be furnished from a stock of screws weighing 38 pounds?

41. Into how many lots of 36 lbs. each, can 3024 lbs. of screws be divided?

42. A job has required the following labor: 4 men 52 hours each, 3 men 5 hours each, 7 men 12 hours each, and 1 man 3 hours. What was the total time on the job?

43. If the above job was divided equally among 25 men, how many hours would each man work?

44. Find the weight of a steel I beam, 18 ft. long, if it weighs 24 pounds per foot of length.

45. At 9 lbs. per foot, what is the total weight of pipe used on a job of piping which requires the following lengths of 3½ in. pipe?

2 pieces each	18 ft.	long
6 pieces each	8 ft.	long
3 pieces each	5 ft.	long
2 pieces each	2 ft.	long
1 piece	6 ft.	long
1 piece	14 ft.	long

46. During a recent month, a blacksmith worked 223 hours at a rate of 34 cents per hour and received as bonus $30.59. What was the amount of his check, one dollar being deducted for hospital fee?

47. At 50 lbs. per foot of length, what is the total weight of 675 steel I beams each 12 feet long?

48. A number of these beams were loaded on a freight car and found to weigh 27000 lbs. How many beams were in the car?

49. An order calls for 24 steel channels, each 17 ft. long, to weigh 25 pounds for each foot of length. What would be the total weight of the steel?

50. A steel rail weighing 100 pounds per yard is 30 ft. long. If its weight be divided equally among 8 men, how many pounds would each man carry?

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Apprentice Schools **Page 340**

Write out the answers to the following questions and hand to your Instructor:

1. In passenger cars what kind of wood is used for siding? Buffer beams? Dust guards? Door frames? Corner posts?
2. In cabinet and furniture work, why is glue used?
3. What is meant by "cleaning up lumber?"
4. Why is veneering frequently used instead of solid wood?
5. What kind of wood warps most? Which least?
6. When would you use nails, and when would screws be preferable?
7. What kind of wood when properly stained, makes the best imitation mahogany? Cherry?
8. How would you prepare work for varnish finish?
9. What kind of sand paper should be used in finishing wood work for Business Cars? What kind for common work?
10. How would you sharpen a cabinet scraper? How a plane iron?
11. What is the result of changing the position of the cap near the cutting edge of a plane iron?
12. What do you mean by the set of a saw?"
13. Give the correct name of each part of an iron smooth plane
14. Why is white pine used for making patterns.
15. How is veneering made and how applied to the head lining of a car?
16. In cabinet work, what kind of joint is the strongest and most durable?
17. What is the market price of No. 1 grade of the following: Oak, Yellow Pine, White Pine, Ash, Cherry, Bay Wood, Poplar, Mahogany?
18. In building a set of furniture for business car in which you use 42 pieces mahogany 1"×10"×12', what would the lumber cost? Suppose 23 pieces 18 inches long are destroyed. How much money has been wasted?
19. In all cabinet or passenger car work, why is it necessary for the lumber to be thoroughly seasoned and dry? Why is the framing of coaches "blocked?"
20. What causes passenger cars to creak while moving?
21. Which class of work do you prefer, cabinet or coach work?
22. If you have not a mitre box, how would you lay off 45°? 30°? 60°? How can you prove it?
23. What is the most difficult job you have ever done?

of charge should any defect develop in them. For the safe keeping of their tools they are furnished, free by the company, a box in which to keep the tools. These boxes being made by the apprentices of the cabinet shop.

SELECTION OF APPRENTICES.

Apprentices are selected from boys living in towns and communities adjacent to the railroad and must be between the ages of 16 and 22, with the exception of some states in which there is a law requiring boys to be eighteen years of age before entering a railroad shop. It is very seldom a boy over 21 is employed. We have found that the best results can be obtained from boys 16 or 17 years of age. They are much easier handled, more easily taught and can more easily adapt themselves to the rules and regulations of their surroundings. The boys must have a common school education, preferably those who have finished the grammar school. Occasionally boys who have had meager opportunities, who are bright, industrious and energetic are employed regardless of their education. Of the applicant who has had unlimited opportunities we require much, but where he has had few opportunities we are very charitable. He shall be required to pass a medical examination and be free from any organic trouble or chronic ailment. He is examined by the school and shop instructors who endeavor to ascertain the qualifications of the boy. We do not care much about the boy's parents so long as the boy himself is strong and industrious. We have found that character letters are about the most useless things that can be written. We ask him a good many questions about himself, his opportunities, length of time he went to public school, why he left public school, what work, if any, he was engaged in before applying for apprenticeship, occupation of his parents, the number in his family, where he spends his evenings, what recreation he engages in, playmates or companions, and often talk to him about his best girl. We endeavor to find out from him as much as possible about himself. This will often govern our method of handling him in the future.

Santa Fe Apprentice Baseball Team at Cleburne, Texas.

Santa Fe System
Apprentice School

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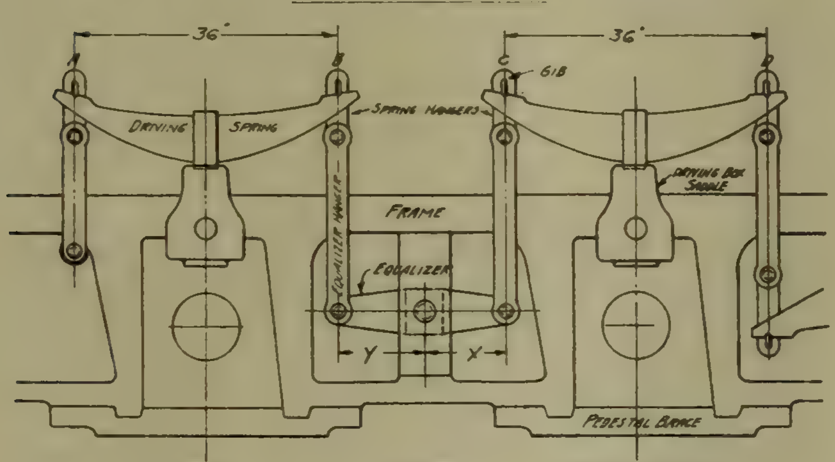

Main Fig. 13. Back-Intermediate

Spring Rigging

423. What will be the pressure on the top of the main driving box, if a weight of 13,000 lbs. is pulling down on the end of the driving spring at A, and 13,200 lbs. on the other end at B?

324. On a locomotive, class 900, the weight applied at the equalizer pin is 26,500 lbs., how many pounds are being applied to the hanger at each end of the equalizer, if dimension X is 11 inches and Y 12 inches? What will be the weight on each hanger if X is 11 inches and Y 11½ inches?

325 Why is it necessary to have dimension X and Y on equalizer of different lengths?

326. On a certain locomotive having spring rigging arranged as shown in Fig. 13, the main driving wheels are found to be carrying too much weight. Which way should the equalizer pin be moved in order to relieve the main wheels of this excess weight? Why?

427. If the weight applied on the equalizer pin on a certain locomotive is 26,500 lbs., where should the center pin hole of the equalizer be located in order to place 200 lbs. more on the larger C than B. The end holes on equalizer are 22½ inches apart.

INDIVIDUAL INSTRUCTION.

We attribute much of the success of our apprentice system to the fact that all instruction is individual. While the boys go to school at certain hours in classes there probably may not be two boys in the whole class who are studying the same question or using the same lesson sheets, as each boy is treated as a unit. The information gathered from the little examination upon entrance, personal characteristics, his education and industry are all considered and carefully weighed, and the boy's instruction is governed by these conditions. A bright, smart, energetic boy passes along as rapidly as he learns the subjects and is not held back on account of the slower and duller boy. The slower and plodding boy moves along only as he masters his subjects. Each must thoroughly know the subject, branches or class of work before he will be moved to another.

PROBATIONARY PERIOD.

The first six months of his apprenticeship is known as a probationary period. He is given every opportunity to de-

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Examinations
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EXAMINATION FOR GRADUATE MACHINIST APPRENTICES.

26 How is a left hand thread cut?

27. How is a double thread cut, and why is it used?

28. Give the names of the different threads you have had experience in cutting.

29. Chiefly, what class of work is termed chuck work?

30. For what purpose are the circular lines found on nearly all chucks?

31 Why should the threads on the spindle be kept well oiled?

32. If you desired to face a concave semicircular surface in the lathe and do it accurately, how would you proceed?

33. To machine a very irregular shaped casting in the lathe that could not be conveniently chucked, how would you proceed?

34. How would you determine the speed of a lathe in feet per minute?

35. What is the most difficult operation you have done on a lathe?

36 In making running fits, drive fits, press fits, etc. are you governed by any fixed rules? If so, state them; if not, why?

37. Explain how the lathe in case of emergency can be readily converted into a horizontal boring mill?

38. For what class of work is the turret lathe especially convenient?

39. Is it better to use high speed, light cut and feed, or slow speed, heavy cut and feed? Why?

40. In what respect are planer tools ground different from lathe tools?

41. What is the most essential thing in setting up planer work?

42. Why should one use as short a bolts as possible in clamping down work?

43. If you were planning a piece of work 24 inches long, would it be correct to use a 35 inch stroke?

44. How long a stroke would you use in the above case?

45. If one of the rail adjusting screws were bent, what effect would it have?

46. How would you plane a 60° bevel?

47. What is necessary to prevent the tool from dragging on a side cut?

48. Is it possibe to perform a radial operation on a planer?

49. Explain briefly how the above is accomplished.

50. How would you graduate on the planer?

Apprentice Band at the Topeka Shops.

velop any talent he may possess and he must show during that six months' period that he has the qualifications for the trade he is indentured to learn. Every thirty days after entering upon his apprenticeship the general foreman of the shop, department foreman, gang foreman, shop instructors and school instructor receive a notice that the boy has served one or more months of his apprenticeship and to pay strict attention to him in order that they may, at the end of six months, be able to pass on his fitness to continue his trade. It is a great deal better that the boy should be dismissed earlier in his apprenticeship rather than allowed to draw along the four years course when he is unfitted for the trade he is endeavoring to learn.

APPRENTICE BOARD.

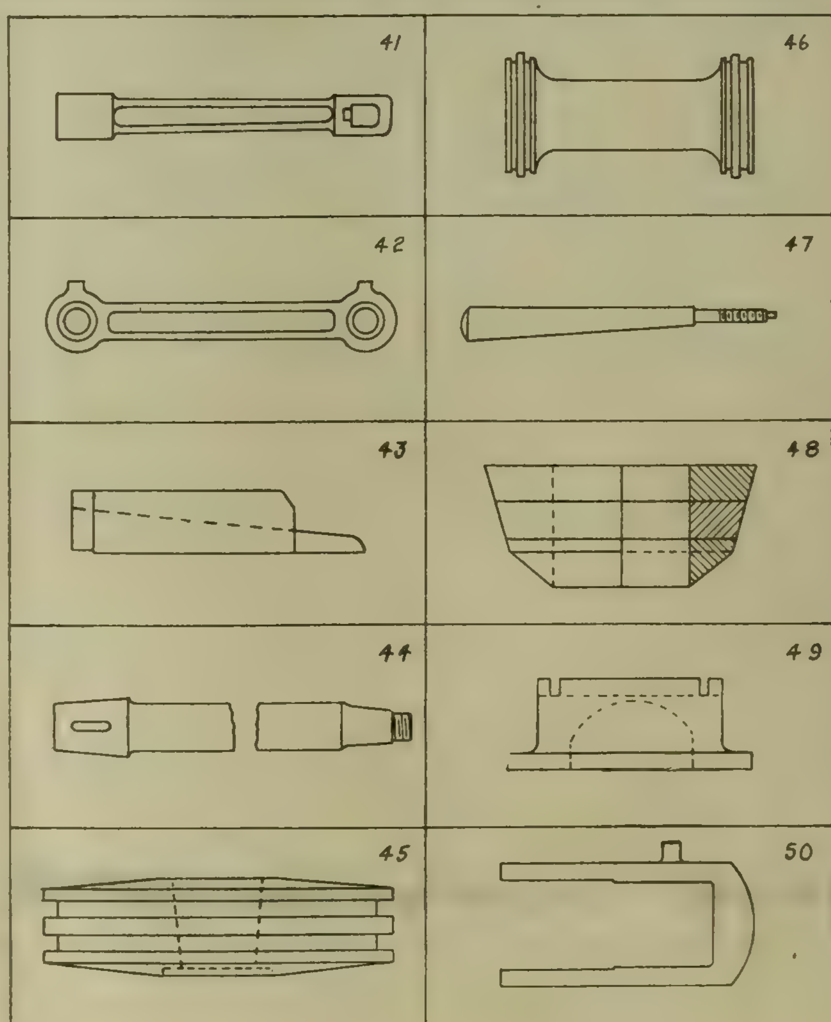
In each shop we have what is known as the apprentice board, a committee composed of the general foreman, department foreman, gang foreman, pit foreman, shop and school instructors. The duty of this board is to pass on all questions in reference to the apprentices. They pass on a boy's fitness at the expiration of his probationary period, pass on all applications for transfer from one shop to another, or from one trade to another. They recommend what discipline, if any, is to be administered to the boy for any infraction of the rules and regulations. This board is a live, active body, anxious to deal out real justice to the apprentice. Each has the same authority and each shows the same spirit or willingness to give the boy the best chance or opportunity posible. The personal prejudice of one man or one member of the board cuts very little figure. But they are anxious that each boy, however poor and friendless, may be given full justice. Any apprentice in the shop has a perfect right to apply to the board at any time that he deems another official has treated him unfairly.

DISCIPLINE.

A modified form of the Brown system of discipline is used for the punishment of apprentices. They are no longer suspended and sent home for any infraction of the rules and regulations but are penalized on their agreement. If a boy is late at work, spoils a piece of work through carelessness, or lays off without permission, instead of being sent home, as is usually done in most shops, he is simply penalized on his agreement the number of days he would have ben sent home. This, of course, lengthens out his apprenticeship all the way from five to fifty hours for each offense. But if the boy, after being penalized, pulls himself together and attends strictly to business and goes six months without any further discipline, the penalty is removed and he is given a clean slate. We have found this to be the most fruitful and beneficial method of disciplining apprentices of any scheme we have tried. Our apprentice agreement, or contract we make with the boy when we employ him as an apprentice, stipulates that we will give him an opportunity to learn his trade and our regulations stipulate he shall work ten hours a day regardless of the number of hours worked by other shop employees,

Santa Fe System
Apprentice Schools No. 255

Make free-hand sketch, give correct name, state where and for what purpose used, material of which it is made, and cost of each article.



with the exception that they may work the apprentices one half day Saturday. Of course, if the shops should close for the entire day the apprentices will not work, nor will they be paid. While other employees may be put on short time in the shops the apprentices are required to work the regular ten hours each day.

The general treatment of the apprentice boys on the Santa Fe is a wholesome one and is a mixture of parental and military treatment. We want them to have the very best time possible while serving their apprenticeship. No one is allowed to abuse or mistreat a boy and no one is allowed to curse or swear at a boy. He is not used as a matter of convenience nor in any sense as a helper in the shop. He is taught from the very beginning that the trade he is indentured to learn is the very best possible occupation for him, that he could not have selected any other work that is better suited to him. In other words, we endeavor to make him happy and contented in his work. The influence of our apprentice schools in the treatment of the boys has shown in the general deportment and action of the other employees in the shop. It is a common saying on the Santa Fe that wherever a Fred Harvey House is built it improves the whole moral tone of the town and it can be truthfully said that wherever an apprentice school has been established on the Santa Fe Railway it has improved the whole moral tone of the shops.

ATHLETICS.

The company provides an athletic field and the boys are encouraged to engage in the various contests. Base ball, foot ball, basket ball, etc., are played in their regular season. Contests with apprentice teams from other points are regular features. The apprentices at three of the larger places have regular brass bands, from 25 to 40 pieces each, also orchestra and glee clubs.

GRADUATES.

Upon graduating or completing his apprenticeship the apprentice is given a handsome diploma showing that he has served an apprenticeship in the shops of this company and that he has become a competent and skilled mechanic, this diploma being signed by the master mechanic, supervisor of apprentices and the assistant vice-president, who is the chief mechanical officer of the system. In addition to this he is given a draft for $135.00 as a reward for faithful and diligent application during his four-year apprenticeship.

RECORDS.

A full and complete record is kept of the apprentice during his four-year apprenticeship. The supervisor of apprentices knows the last day of the previous month the number of drawings he has made in the school room, the number of

Center, lower row: M. J. Drury, Supt. Shops, Topeka; on his right, C. W. Cross, Supt. Apprentices, New York Central Lines, and on his left, F. W. Thomas, Supt. Apprentices, Santa Fe System. All others, apprentice instructors Santa Fe System.

Personal Characteristics of

Walker, George R. Boiler Maker Apprentice

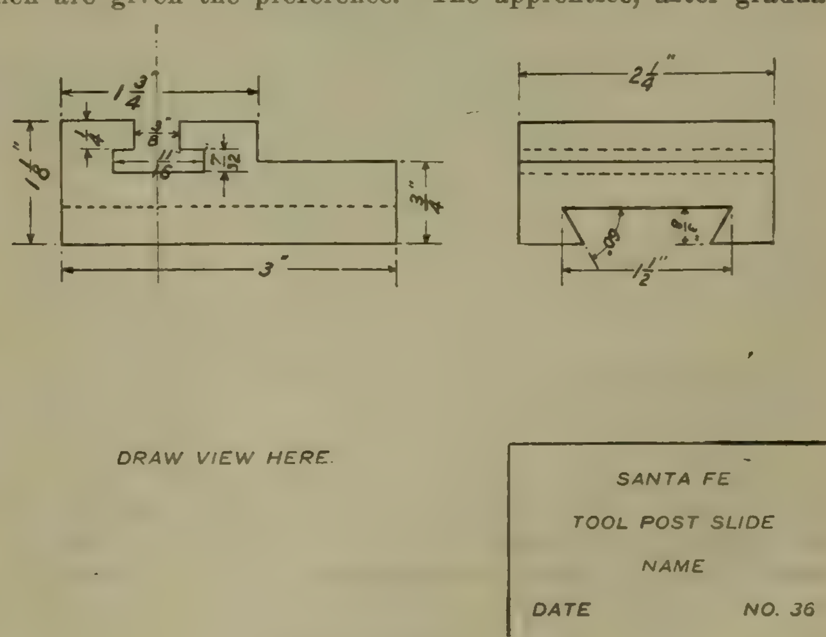
La Junta, Colorado 9131 hrs

(Please fill out personally, without assistance or knowledge of any other person, indicating with check mark in column. Mail direct to Supervisor of Apprentices, Topeka.)

	Very Good	Good	Medium	Poor
Education			✓	
Special knowledge			✓	
Experience		✓		
Honesty	✓			
Morality	✓			
Temperance	✓			
Tact		✓		
Resource		✓		
Reliance		✓		
Foresight		✓		
Appearance			✓	
Memory	✓			
Energy		✓		
Industry		✓		
Initiative		✓		
Persistence		✓		
Assertiveness			✓	
Discipline	✓			
Promptness	✓			
Accuracy			✓	
Personality			✓	
Loyalty	✓			
Executive ability			✓	
Shop work		✓		
School work		✓		
Popularity with authorities		✓		
Popularity with associates		✓		
Is he making good? yes				

Date Dec. 31, 1913 H. L. Shipman, Apprentice Instructor.

problems he has made, other lessons he has learned, and what work he has done in the shops. He may do a dozen different jobs during the month but each is recorded, also the number of hours he is absent from work for all causes, and four times during his apprenticeship the shop and school instructors are required to fill out a blank showing his personal characteristics, this blank having 28 subjects which the instructors must grade him on as being "very good," "good," "medium" and "poor." They also advise the supervisor of apprentices at the completion of his apprenticeship if the young man has shown any qualification for leadership, in other words, whether he is material for the making of a foreman. Such names as have the above qualification for leadership are sent to the mechanical officers and when any need a foreman these young men are given the preference. The apprentice, after graduat-



Simple Drawing Lesson.

ing, is not forgotten or turned loose. We still keep a watchful eye on him and continue to assist and direct him when in need of help. We keep a record of him if he is transferred to another shop on the system, and even if he leaves the service we still keep track of him. We know where they all are today, know what they are doing, even the wages they are receiving. Seventy-five per cent of all the apprentices or graduates who have left our service have, within six months, applied for re-instatement.

ORGANIZATION.

The organization of the apprentice department on the Santa Fe consists of the supervisor of apprentices who has charge of all matters relating to the apprentices and he reports to the assistant vice-president in charge of mechanical operation. He has a central office wherein all lesson sheets, problems, etc., are made and sent out. A complete record of each apprentice is kept in his office and all indentures for apprenticeship are approved by him. A set of rules and regulations governing the apprentices are published by the supervisor of apprentices and approved by the assistant vice-president and these rules are applicable to all apprentices. In addition to his office force all of the large points have one or more school instructors, who are appointed by the supervisor of apprentices, and each shop has an instructor for every 25 boys, the shop instructors being selected by the local shop authorities with the approval of the supervisor of apprentices. The senior shop officials are the employing officers, employing all the apprentices in the shops, but these must be examined by the shop and school instructors.

Certificate Given to Santa Fe Apprentices.

RESULTS

The apprenticeship system on the Santa Fe has proven its efficiency from the very beginning, due primarily to the fact

that it has the earnest personal and official backing of all the officers of the company from the president down. In a short while the schools became the pride of the local shop, officials and visitors are generally shown the apprentice school by the master mechanic with a great deal of pride and pleasure. The present apprentice system has become a fixture in our shops and is considered as much a fixture in the shop as the power house or tool room. If the shop instructor is absent for any cause for more than a day we generally hear a howl from the shop foreman as to "when is that instructor coming back." There has never been the least friction as to conflicting authority between the foreman and instructor. They have always worked most harmoniously, the one helping the other. In the absence of the foreman for a day or more the instructor generally runs the shop. In the absence of the instructor the foreman does all in his power to assist and instruct the apprentices. The apprentice system on the Santa Fe has never been considered as a matter of convenience but has always been treated as a recruiting system for filling the shops with men of our own making and training. While the system has been more than sustaining from the very beginning, this fact alone was never considered.

Set of Tools for Woodworking Apprentices.

During the six and one-half years that our present system has been in operation 70 per cent of all the graduates are still in service and 93 per cent of all the boys graduated during the year 1913 are in service. About 12 per cent of the graduates have been given some official position. A great majority of these have more than made good.

Those interested in the modern method of educating and training apprentices or considering inaugurating such a system will do well to consider that it is necessary to have one man as head of the system who will have full and complete authority and general management of the scheme. Also that the school work must be made entirely practical and free from college frills and that a full corps of shop instructors will be a most fruitful branch of the system, that the whole scheme shall be considered one of recruiting rather than one of convenience.

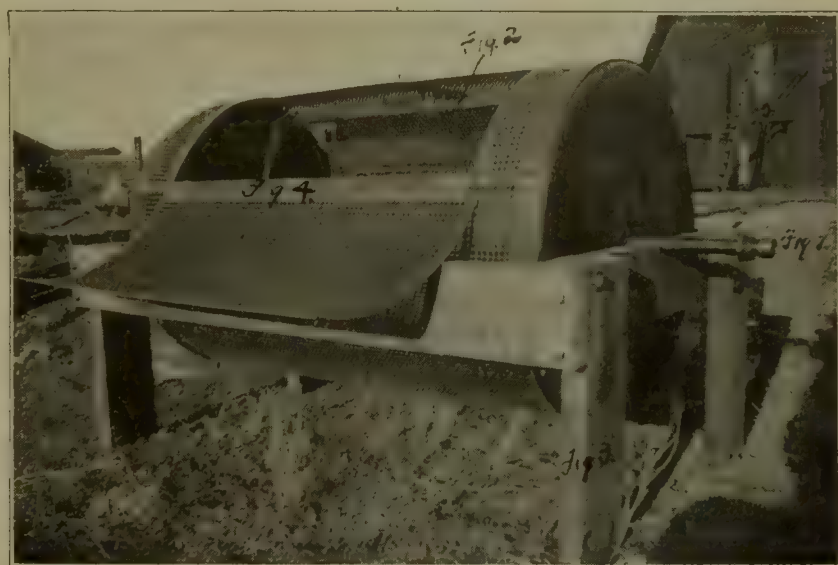
Seventeen years ago one of our mechanical department officers, who was then master mechanic, realizing the disadvantages and drawbacks of mechanics who were not familiar with mechanical drawing and not having the opportunity himself as a boy while serving his apprenticeship, determined that the apprentices under his jurisdiction should not be so handicapped. He engaged a room and employed a competent instructor paying for both from his own pocket and opened a night school for the apprentices in his charge. It must be a pleasure to him in knowing that more than half of these boys have filled official positions on this road, this being evidence that his efforts were appreciated, and further that his efforts were a success is evidenced from the fact that today there are over 800 apprentices on the Santa Fe System who are being trained by 36 instructors.

[Mr. Thomas will be glad to furnish, through our columns, any further detailed information desired by any of our readers. —EDITOR.]

JONES WASTE CLEANER.

By Isaac Jones, Chf. Inspector, Colo. & Sn. Ry.

About three years ago on our road new packing was used to repack all journal boxes, the old dirty waste being generally picked up by the roundhouse men and used to light fires in locomotives. We ran out of new waste with which to make packing on one occasion and I put one of the men to shaking the dirt out of the old packing, resaturating it and using it over again. At this time the cost per 1,000 miles for freight car lubrication was 15 cents. I noticed that we were making a considerable saving by using the old packing, and so I built and put into operation a machine for cleaning the packing, first applying for a patent on the process, which was allowed.



Jones Waste Cleaner.

In the photographic illustration the machine is shown without its sheet iron hood. Fig. 4 in the illustration indicates the perforated cylinder in which the waste is revolved in cleaning; Fig. 2 indicates the perforated steam pipes through which steam is forced at 80 lbs. pressure. The perforations in the pipes are 1/4-inch in diameter, are spaced in 6-inches apart and are staggered so as to blow in all directions inside the cylinder. Fig. 1 shows the same piping as Fig. 2, entrance being made by means of brass stuffing boxes through each end of the cylinder. The bottom frame is enclosed with sheet iron and there is a sheet iron pan placed under the machine to catch the dirt. We have organized the Cheyenne Railway Supply Co., Cheyenne, Wyo., to place the machines on the market. All machines to be built in the future will have frames of 1 1/4-inch pipe instead of wood and will be equipped to run by means of a small friction pulley or crank. The machine shown in the illustration is the first one placed in service.

This machine has reduced the cost of car lubrication from 15 cents per 1,000 miles in 1911 to 3 1/2 cents in 1913-14. We hardly ever run over 4 cents. The process takes out of the packing all short dead strands; also all burnt waste, all gravel and dirt without any loss of oil except what is retained in the dirt removed. The cost is $3.00 per ton, with a loss in dirt and burnt waste of 8 pounds per 100 pounds. We save all of the babbitt metal, our process separating it from the packing. The machine can be run by power or by hand and occupies a space 4x5 feet.

A BRICK ARCH IN LOCOMOTIVE PRACTICE.

By L. D. Royer.

The brick arch is a boiler accessory that has had the attention of railroad men for a number of years, yet it is only within the last few years that any decided steps have been taken towards perfecting this device so that its use could be extended and made practicable under all conditions of locomotive operation.

We all agree that smoke escaping from the stack is a waste, and the greater the volume of smoke the greater the loss. The emission of black smoke is a sure indication of imperfect combustion. It is also a sure sign that there is some condition, either mechanical or human, existing that is detrimental to combustion and the question is: Can the emission of black smoke from the stack of a locomotive burning bituminous coal be prevented and how can it be done?

It must not be assumed from the above statements that the absence of smoke is a sign of perfect combustion, as there are invisible gases, which may escape, which have a high calorific value, but the point I wish to bring out is that the presence of smoke is a sure indication and one which is readily observed, while with the invisble gases special apparatus and chemical analysis is necessary to collect and determine the amount of combustible gases which are escaping.

A great deal has been written about methods of firing, most of them good when possible to follow them, but none of them sufficient to approach perfect combustion in the firebox of a locomotive.

Bituminous coal, which is used almost exclusively, consists principally of fixed carbon which burns on the grate with little or no flame and volatile matter which in different coals differs greatly in character. It is this volatile matter in coal with which we are most interested in studying combustion and the abatement of smoke, so before going further we will discuss briefly the volatile matter in coal as to its properties.

The bituminous coals yield volatile matter containing large amounts of tarry vapors and hydrocarbons difficult to burn without a considerable excess of air and a high temperature.

Visible smoke consists of solid carbon particles and solid or liquid hydrocarbon particles or "tar vapor." Both result from incomplete combustion of the volatile products of the fuel. The carbon of the smoke is not derived from free carbon in the fuel, but is deposited by the cooling of hot dissociated hydrocarbon gases. Flame is a phenomenon accompanying the chemical union of certain gases, one of which is usually oxygen; and the incandescent particles made the flame visible. If some of these particles in the flame are carbon formed by the dissociation of hydrocarbons, luminosity results, and if the temperature of these particles is reduced below the point at which they combine with oxygen, or if sufficient oxygen is not at hand to effect the union, they fail to unite with oxygen, and pass off as solid carbon in smoke.

When a coal produces rich volatile gases bearing large amounts of heavy hydrocarbons, a comparatively large combustion space must be provided to allow the flame to be burned out before striking cool surfaces; and the flame must have an adequate supply of air at a sufficiently high temperature if it is to be burned out in time.

Furthermore, when rich volatile products distill rapidly from a coal at medium or low temperatures, they must be taken care of by increased combustion space or by decreased rate of firing. The essential requirements of smokeless combustion are therefore, three: (1) Sufficient combustion space, (2) sufficient air at a high temperature, and (3) sufficient thorough mingling of gases and air.

Reduction of boiler efficiency may be due to several causes, chief among them being loss of sensible heat, loss of cinders, and loss of combustibles through the stack. That the last named factor is of large influence it seems safe to conclude from the general rule that high rate of firing involves increase of unconsumed combustibles in the stack.

In view of the high rate of firing and the small combustion space in a locomotive, any refinement that will increase the combustion space or cause a more intimate mixture of the combustibles in the firebox will decrease the amount of unconsumed combustibles in the stack with a corresponding increase in boiler efficiency.

The locomotive firebox is always found to be as small as the grate propertions will permit.

The only thing that can be done in the way of improvements for this type of furnace is to install a brick arch which divides the furnace into two compartments, a furnace chamber and a small combustion chamber, taken from the furnace chamber space.

The brick arch accomplishes a great deal considering the limiting conditions. The flame travel is greatly increased, resulting in a better mixing of gas and air. The temperature is greatly increased as proven by authentic tests.

The brick arch adds to the firebox capacity and the fireman's capacity on account of the fact that more complete combustion forces the coal to yield a higher percentage of its total heat units.

The brick arch saves coal because of the better combustion and because of the baffling and retaining effect on the gases and on the light combustible matter which without the arch would be drawn through the flues in the form of sparks or partly consumed combustible gases.

The brick arch abates the smoke and cinder nuisance on account of the more thorough combustion due (1) to the better mingling of the gases and oxygen of the air drawn into the furnace chamber and (2) due to the fact that the longer flame travel gives more time for combustion to be completed before the gases pass into the flues.

The brick arch affords protection to the flues. This statement can be verified by inquiring of almost anyone responsible for the up-keep of flues who has had opportunity to observe the difference in this respect between engines equipped with an arch and those not so equipped.—*Pere Marquette Magazine.*

A MIX UP.

The mess made by some car letterers and numberers in the repair shops at Denver, Colo., when one set of numbers were placed on one side of a car and another entirely different set on the other side of the car may easily be imagined. Conductors found that they had an extra car in their trains. Tracers could not find the missing car. Finally some freight conductor who had drawn the "hoodoo car" thought to investigate and discovered the error. The mistake had gone undetected for nearly eighteen months and had caused inestimable trouble to the operating and traffic departments.—*Railway Record.*

RAILROAD PHONETIC SPELLING.

Albert Kern, of the Western Union Telegraph Company, tells this one:

"Some years ago I was agent at a small station in Texas through which the International & Great Northern Railroad ran. One day a typical backwoodsman was standing on the station platform intently watching, perhaps for the first time in his life, an engine switching cars in the yards. On the tender were the letters 'I. & G. N.,' meaning International & Great Northern. He spelled the letters over slowly to himself and then said: 'I-&-G.-N? That's a —— of a way to spell engine, ain't it?' "—*Disston Crucible.*

The Illinois Central will build a hospital at Chicago for its employes costing $400,000. A building permit has been issued, and it is expected that work will start in the near future. The hospital is to be located at Fifty-eighth and Stony Island avenue.

HIGH SPEED PASSENGER LOCOMOTIVES.
Oakland, Antioch & Eastern Railway.

Business has increased so rapidly since the opening of the Oakland, Antioch & Eastern that in order to cope with the heavy through passenger traffic between San Francisco and Sacramento it has been necessary to place in operation two 62-ton electric locomotives. The use of electric locomotives for hauling passenger trail cars instead of using multiple-unit cars is a new and noteworthy departure in the electric railway field. The phenomenal growth in traffic mentioned above is largely due to the opening up of new territory which has been heretofore practically inaccessible to the Bay Cities except by long round-about steam route.

The locomotives are of the 2-4-0 articulated truck type and each is equipped with four Westinghouse No. 308-D-7, 250 h. p. 600-1200 volt commutating pole motors and type HLF unit switch control.

Each locomotive when operating at a balancing speed of approximately 56 m. p. h. is capable of hauling a train of five steel passenger trail cars, weighing 37.5 tons each, on a level tangent track with 1,100 volts direct current on the trolley. With only three of these cars one of these locomotives under the same track conditions is able to attain a balancing speed of about 60 m. p. h.

The mechanical parts were built by the Baldwin Locomotive Works. There are two articulated trucks, each having six wheels, four of which are drivers, making a total of eight drivers per locomotive. Each group of wheels consisting of two pairs of driving wheels and one two-wheeled radial truck has an independent frame. These two truck frames are connected together with an articulation link. The cab is mounted on a separate frame, which is supported on the truck frames by eight spring loaded friction plates, no drawbar pull being transmitted through the cab. The cab center pins carry no weight and are used simply to maintain the position of the cab with respect to the trucks.

The truck side frames are steel castings of the steam locomotive type, 3½ inches wide, with their centers 76 inches apart transversely. These frames have renewable wearing gibs on the pedestals, and are designed in accordance with steam locomotive practice, except that in the present instance it is unnecessary to use a tempered pedestal and wedge. The two-wheeled trucks under the ends of the locomotive are of the modified Rushton type with radius bars, and are equalized with the driven wheels. In each group of wheels the equalization is continuous on both sides of the locomotive.

The truck frames are strongly braced transversely at each end, and also at two intermediate points. The crossties at the inner ends of the frames have radial faces which bear against each other. These crossties are provided with spring buffers placed 38 inches apart.

In negotiating curves the inside buffers are compressed, thus tending to restore the alignment of the frames after the curve has been transversed. These buffers, being in contact at all times, also help to promote steady riding when passing over rough tracks.

The cab underframe is a built-up structure composed of channels, plates and angles. The longitudinal sills are four in number and they consist of 8-inch channels which have a length of 33 feet, 11¼ inches. The width over the outside channels is 8 feet 10 inches. This structure is spring supported at eight points, four on each truck frame. The end supports are 37 inches apart transversely, and the center supporters 90 inches apart. Longitudinally these center supports are placed close together as they are mounted near the ends of their respective truck frames. With this arrangement a minimum amount of shock is transmitted to the cab frame when the locomotive is running, and at the same time the trucks are maintained level under conditions of weight transfer due to the high tractive effort exerted by the motors. The center pins which hold the cab frame in alignment with the trucks are 14 feet 8½ inches apart. One of these pins is allowed a limited amount of longitudinal movement in the center plate on the cab frame. This is in order to compensate for the varying distance between truck centers when the locomotive is traversing curves, and to relieve the cab frame from buffing shocks.

Electric Locomotive, O. A. & E. Ry.

The cab is of steel plate with a hardwood floor. It is arranged for double end operation and is provided with a convenient arrangement of doors and windows. These are of such size that all the cab equipment can be removed through them. All walking platforms outside the cab are of rolled steel checker plate, and the arrangement of steps and handholds conforms to the requirements of the International Commerce Commission.

These locomotives are equipped with headlights, pilots and automatic couplers at each end. The couplers have radial drawbars, which are provided with centering springs. This is an important feature, as in service these locomotives traverse curves of 100-ft. radius. The equipment also includes air sanders front and back and combined air and hand brakes on all driving wheels. One standard locomotive bell and two air whistles are supplied. The driving wheels have cast iron centers with steel tires shrunk and bolted, while the truck wheels are of rolled steel.

The principal dimensions of these locomotives are as follows:

Gauge, 4 feet 8½ inches.
Wheel base, rigid, 7 feet 4 inches.
Wheel base, total, 31 feet.
Driving wheels, diameter outside, 42 inches.
Driving wheels, diameter center, 37 inches.
Driving journals, 5 inches by 9 inches.
Truck wheels, diameter, 30 inches.
Truck journals, 4½ inches by 8 inches.
Width overall, 10 feet.
Height to top of cab, 12 feet.
Length, center to center of coupler knuckles, 39 feet.
Weight on driving wheels, 86,000 lbs.
Weight, total engine, 124,000 lbs.

In the right-hand corners of the cab are mounted the master controller, engineer's brake valve and sander valves. These locomotives are designed for double-end operation. The reversers or series parallel switches are placed next to the floor, the switch groups and line switches directly over them, and the resisters directly over the switch groups under the roof.

The grid resistors are mounted in the main cab over the switch groups and are enclosed in a steel cabinet open at the bottom and provided with hinged doors on each side, so as to provide easy access.

Ventilators are provided in the roof over the resistance

cabinet of such a type as to give free egress to the heated air and to prevent rain from entering.

Forced ventilation is supplied by blowers mounted on the extended shaft of the dynamotors.

The advantages of this centralized arrangement are numerous, and may be briefly summed up as follows:

All the control apparatus is assembled compactly in one part of the locomotive instead of being scattered in different locations.

The switch groups are located in such a position that they are readily accessible from all sides and they are at such a height that a man can get at them freely without working in a cramped position, or inside the hood.

Each locomotive is propelled by four Westinghouse electric 250 horsepower motors. These motors are of the commutating-pole box frame type arranged for field control.

The field of each motor has four coils, each of which is divided into two parts, one having a greater number of turns than the other. However, these two coils are insulated from one another, but bound so as to make one unit. Since these motors are of the field control type the field coils are connected in two circuits, one made up of the coils having the larger number of turns and the other of the coils with the least number of turns. In accelerating where a large tractive effort is needed, both these field circuits are connected in series, thus giving a strong field; and after the motors get up to speed the circuit containing the coils with the fewer number of turns is cut out; then the motors operate on short field.

Two dynamotors are mounted on each locomotive. These operate the compressor and blowers and supply the required amount of 600-volt direct current for lighting the passenger cars, the locomotive, headlight and for operating the control. Each compressor has a capacity of 35 cubic feet of free air per minute.

The air brake, built by the Westinghouse Air Brake Company, are of the type EL especially designed for electric locomotive service.

GAUGING LIFT OF AIR PUMP VALVE.

By J. A. Elliott, Air Brake Fmn., I. C. R. R.

When repairing air pumps it is very necessary that air valves have a correct amount of lift. The best of mechanics are apt to make mistakes when measuring for the lift of air valves, and when this job is given to the apprentice the chances for mistakes are greater. The gauges in the accompanying sketches were made to overcome all this trouble. They are so complete that there is absolutely no chance to make mistakes, and this work could, if necessary, be performed as well by a sweeper as by a mechanic.

The quarter inch pin in the center is held secure when adjusted by a 3/16th inch set screw. This pin is exactly the same length as the two legs of the gauge, and thus requires only one adjustment to gauge the lift of a valve, there being used a small brass button the thickness of which is equivalent to the lift of the valves which you are gauging. It is necessary to have two gauges, one for the lower cage and one for the upper cap.

When using the cage gauge shown in Fig. 1 place the upper ends of the gauge legs against the cage joint of the pump cylinder and gently push pin in until it touches the valve boss in the cylinder. Then secure the pin in this position by means of a set screw. Now with valve in position in cage and brass button on top of valve, the pin should just touch the button when lower ends of gauge legs are placed on joint of the cage, as shown in Fig. 2.

When using the cap gauge shown in Fig. 3, place the valve on the upper seat in cylinder and place the upper ends of the gauge legs against cap joint on cylinder and gently push the pin in until it touches the valve. Secure the pin in this position by means of the set screw and with the brass button on the cap boss the pin should just touch the button when the lower end of the gauge legs are placed on the joint of cap shown in Fig. 4. The dimensions of these gauges are made to suit the cages and caps of the different sizes of pumps.

THE UNIVERSITY OF ILLINOIS has just concluded the series of tests which have been in progress at its locomotive testing laboratory on the Illinois Central consolidation type freight locomotive No. 958.

This engine was furnished by the Illinois Central for the purpose of these tests and was placed in the laboratory about a year ago. Since that time many tests have been made by both the faculty of the college of engineering and students in the railway courses. The highest speed at which any tests were made was 45 miles per hour. The greatest tractive effort registered was 30,000 pounds, while the highest horsepower developed was 1,650.

The tests were conducted primarily to increase the efficiency of the locomotive performance. Considerable work was also done during their progress to improve the running of the locomotive. The data secured is now being worked up by the members of the railway department and the results of the tests will soon be known.

The Southern is preparing to make an initial expenditure of $750,000 for classification yards and shops near Birmingham, Ala. The company owns 112 acres of land near that city which will be used for this purpose. Work will begin at an early date on the locomotive and car shops, and it is expected that the total cost when complete will be about $1,500,000.

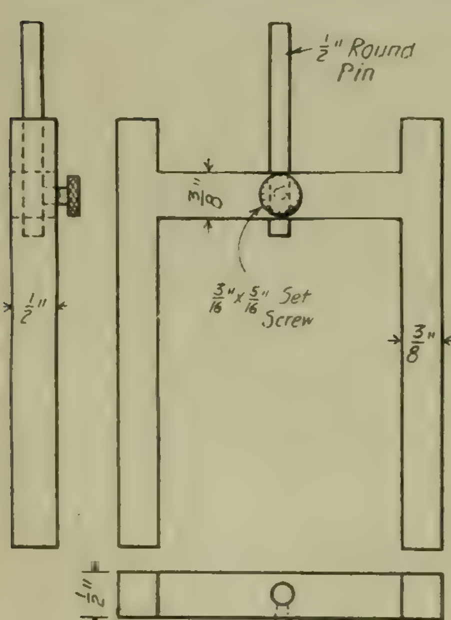


FIG. 1
Gage for Air Valve Cage.

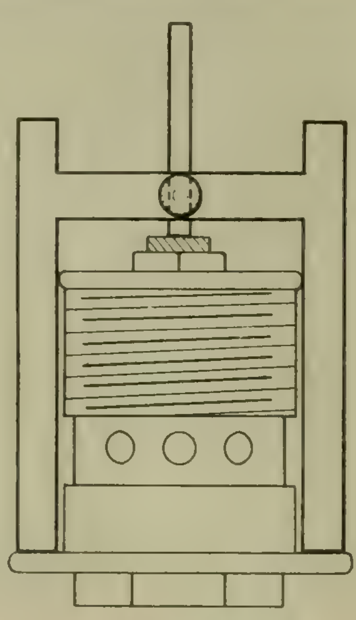


FIG. 2.
Gage Applied to Cage.

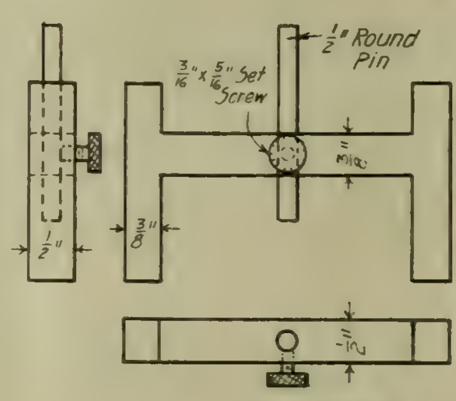


FIG. 3.
Gage for Air Valve Cap

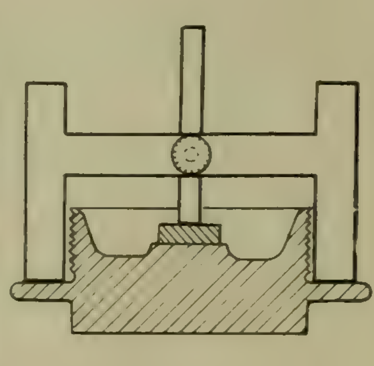


FIG. 4.
Gage Applied to Cap.

Device for Gauging Lift of Air Pump Valves.

Air Line Junction Improvements

The Lake Shore & Michigan Southern is now constructing at Air Line Junction, O., new engine terminal facilities and freight car repair shops to take care of all freight engines and cars which converge from divisions east and west of Toledo. The engine terminal facilities include one 90-foot 27 stall engine house, one 105-foot 13 stall engine house, machine shop, power house, sand house, coaling plant, cinder pits, etc.

ENGINE HOUSES.

The 27-stall engine house is 90 feet deep. There are two 13-inch brick fire walls dividing the house into three sections of nine stalls each. This building is used for giving light repairs to heavy freight engines. No drop pits are provided. Room for the extension of 17 stalls to this house has been provided for.

The 13-stall engine house was made 105 feet deep in order to give adequate space for repairs to Mallet type locomotives. It is provided with both driving wheel and truck wheel drop pits. The driving wheel drop pit is equipped with an eight-ton pneumatic jack mounted on a four-wheel narrow gauge carriage which is actuated by an air cylinder attached to wall of pit. The truck wheel drop pit is equipped with a three-ton pneumatic jack mounted on a four-wheel carriage which is actuated by hand. Room for extension of 33 stalls to this house has been provided for.

Both the 17 and 13-stall houses have a maximum height of 22 feet from top of rail to bottom of roof truss. Foundations are made of concrete; walls of brick; roof trusses, window frames and columns of wood; smoke jacks are made of asbestos board. The wood is used in construction on account of the deterioration of structural steel, due to the gases and moisture from the engines. Composition roofing is used throughout. Great care was taken in designing the buildings to provide all the natural light possible, and also allow the smoke and gases to escape quickly. In addition to the ordinary windows there is a monitor roof which extends all around the house. This has large windows in either side affording excellent natural light in center of house. The windows in the outer wall are of the triple sliding sash type. The windows in the monitor are of the double sliding sash type.

The engine pits are made of concrete, heavily constructed, the bottoms being lined with selected hard burned foundation brick. Walls have cast iron coping on top which forms a base and anchor plate for 80-pound rail. For the 27-stall engine house they are 65 feet long, 3 feet 10 inches wide, 3 feet 2 inches deep at high, with slope of ⅛ inch per foot. For the 13-stall engine house they are of the same dimensions as above, except they are 78 feet long.

HEATING AND VENTILATING.

The heating system is of the indirect type furnished by the Green Fuel Economizer Co. It consists of three separate units, two for the 27-stall engine house and one for the 13-stall engine house. Each unit contains a heater, fan and engine. The heater has 8,875 lineal feet of 1-inch pipe, in five sections, which has a heating surface of 2,960 square feet. The fan wheel is 10 feet in diameter by 55 inches wide at periphery and delivers 75,000 cubic feet of air per minute when running at a speed of 150 R. P. M., and is driven by a 11 x 14 inch 35 H. P. horizontal steam engine.

With the above units a complete air change can be made every eight minutes. A temperature of 65 degrees is maintained within the house when the outside temperature is 10 degrees below zero, and 25 per cent of the air passed through the heater is drawn from the inside of the engine houses and recirculated.

The air ducts from fans to engine pits consist of one large main duct which extends around the outer circle of engine house with branch leading to four screened inlets at each engine pit.

The heating units are housed in separate buildings located 18 feet from engine house, two units being located in building adjacent to 27-stall house and one unit located in building adjacent to 13-stall engine house.

LIGHTING.

Engine houses are illuminated by 250 watt tungsten lamps with white enameled steel Holophane reflectors hung 15 feet above floor. One row is hung near outer circle of building and one row is hung in center between pits. On the 27-stall engine house there are six 250 watt lamps with Holophane reflectors hung over doors on outside of house, and on the 13-stall engine house there are three 250 watt lamps with Holophane reflectors hung over doors on outside. These are for the purpose of illuminating tracks between turntable and engine house. Plug boxes are located on posts and suitable places on walls for hand extensions.

PIPING.

The piping in the engine houses consists of washout, filling, blowoff and cold water system, steam blower, and compressed air lines.

The washout, filling, blowoff and cold water piping is carried overhead on rollers with suitable drops located on middle row of posts throughout engine houses; also flexible connections are provided overhead for blowing off and filling through dome of engine. The main blower line is 3-inch with 1-inch flexible drop at each pit. The main air line is 2½-inch with 1-inch flexible drop located on middle row of posts throughout engine houses.

TURNTABLES.

Both engine houses are equipped with turntables 90 feet long driven by electric tractors furnished by Geo. P. Nichols & Bro., Chicago. Each tractor is equipped with a 22 H. P., 440-volt, 3-phase, 25-cycle alternating current motor.

ENGINE HOUSE OFFICE.

This building is of the same general construction as the engine house, and is located at end of 27-stall engine house, and adjacent to cinder pits, thereby being conveniently located for enginemen and firemen to get to register room. The building is 18 feet wide by 62 feet long and divided into rooms for the following: Despatchers, bulletin, register, engine house foreman, road foreman of engines, chief clerk and filing.

The building is heated by direct radiation, using low pressure steam and wrought iron pipe radiators, and is illuminated with 25 and 60-watt Mazda lamps with Holophane reflectors.

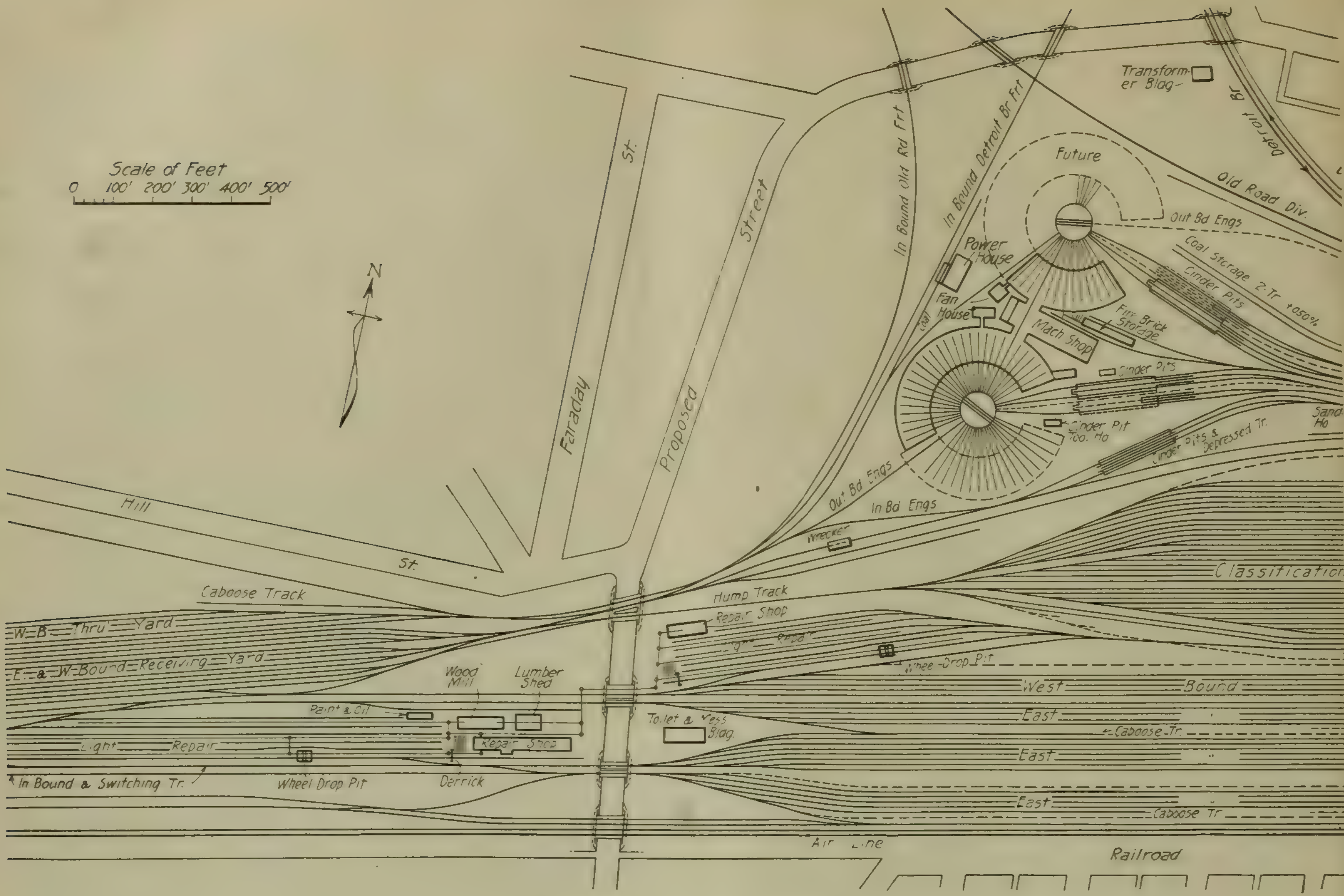
MACHINE SHOP.

This building is located between the two engine houses and is of the same general construction as the engine houses, except that the roof trusses are of steel instead of wood. It is 62 feet 6 inches by 250 feet, and also includes the blacksmith shop, heater room, tool room, store room, oil house, electrician's room, locker room, toilet rooms, examiner's room, waiting room and bunk room. The bunk room is located on the second floor over the five last named rooms.

The machine shop occupies an area of approximately 7,775 square feet. In one end is located an erecting pit. Tracks lead from this to each engine house. The pit is served by two Shaw-Electric 75-ton cranes used for lifting engines. The hoisting machinery is stationary but the bridge is traversed by hand, the controller for hoist being located on the floor. The balance of the machine tool equipment consists of a 4-foot radial drill, 24-inch shaper, 30-ton hydraulic press, 48-inch engine lathe, 18-inch engine lathe, two 10-inch engine lathes, No. 4 belt cutter, 32-inch by 32-inch by 9-foot 8-inch planer, 2-inch by 18-inch double emery wheel. Machines are arranged in one group and driven by a 15 H. P., 4401volt, 3-phase, 25-cycle alternating current motor.

The blacksmith shop is 20 by 50 feet and contains the following equipment: 200-pound Bradley hammers, two 5-foot standard forges, two anvils, 1,000-pound jib crane, No. 7½ Buffalo blower. Blower and Bradley hammer are driven by a 10 H. P., 440-volt, 3-phase, 25-cycle alternating current motor.

The heater room is 18 by 60 feet, floor line of which is 5 feet below that of machine shop and engine houses. It contains two tanks each 10 feet in diameter by 20 feet long, one for storage



Layout of Terminal at Air Line Junction.

of hot water for filling boilers and the other for storage of washing out water. In connection with these tanks are two 14 by 10 by 12-inch duplex pumps, one for filling and one for washing out. The system was furnished by the National Boiler Washing Co.

The machine shop building is heated by direct radiation, steam being supplied to pipe coils at 5-pound pressure, and is illuminated with 25 to 100-watt Mazda lamps with Holophane reflectors.

OIL ROOM.

This room is provided with a basement for the storage of the various kinds of oil, except the fuel oil, which is stored out in yard in two 6,000 gallon tanks. Bowser long distance pumps are located in the store room for drawing the oil. The first floor is used for shifting oil barrels when storage tanks are filled by gravity from the barrels. A balcony 18 feet 7 inches by 18 feet is located 9 feet 6 inches above first floor for the storage of baled waste. A suitable hoist on a runway directly over balcony is provided for lifting the bales. Track boxes are located outside of oil houses on service track so that tanks can be filled with oil from tank cars.

The following oil storage is provided for: 12,000 gallons of fuel oil, 3,300 gallons of headlight oil, 1,500 gallons of signal oil, 1,500 gallons of valve oil and 1,500 gallons of car oil.

POWER HOUSE.

This building is 44 feet wide by 84 feet 4 inches long, floor line of which is 8 feet six inches below ground. This section below ground line and foundation is built of concrete, while the upper walls are brick. The roof trusses are of the Fink type, made of steel. The elevated ash storage bin is also made of steel. The power house equipment includes three McNaul horizontal water tube boilers, 250 H. P. each, fed by Taylor three-retort stokers, two 10 by 6 by 10-inch Canton-Hughes outside end packed plunger type feed water pumps, one Cochrane open type feed water heater, one Ingersoll-Rand 1,500 cubic foot air compressor driven by a Westinghouse Company's self-starting 249 H. P., 4,000 volt, 3-phase, 25-cycle synchronous motor mounted on main shaft of machine. An after-cooler and storage tanks for air are located outside of power house. The ash hoist is of the skip-bucket type actuated by air and is located in front of boilers. A suitable ash storage bin has been provided directly over ash hoist. Natural draft is obtained by a 150 feet by 6 feet 6 inches brick chimney.

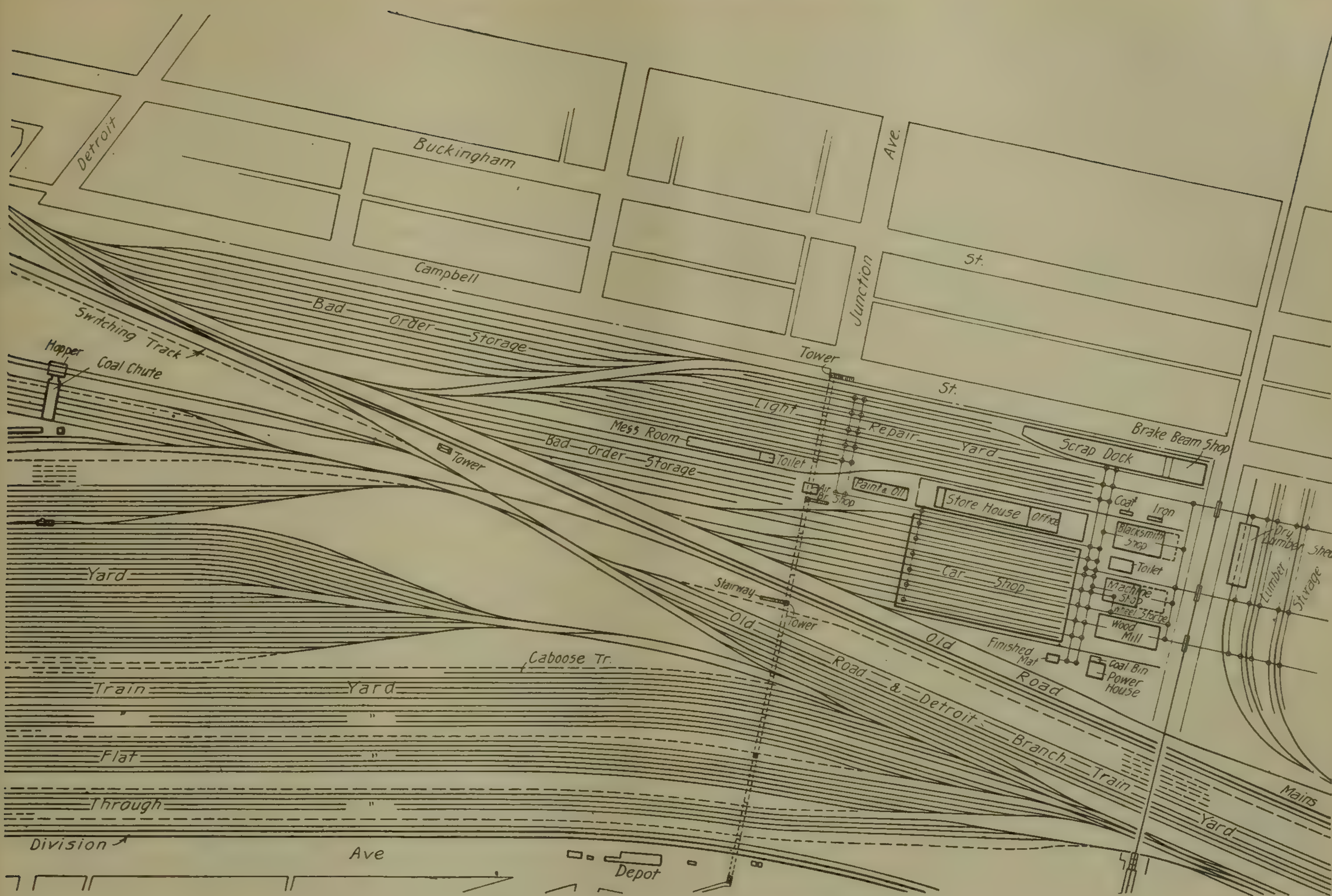
Electric current for all purposes is purchased from the Toledo Railways & Light Co., and supplied to the switchboard at 4,000 volts, 25-cycle. This is transformed to 440 volts for power and 110 volts for lighting. All high-tension circuits are controlled by oil switches with automatic release.

SAND HOUSE.

This building is 14 feet wide by 103 feet long and is constructed of concrete and wood, having a green sand storage of 440 cubic yards. The dryer is of the gravity type heated by steam, the drying space being 6 by 13 feet with two receiving tanks beneath these tanks have semi-automatic valves so that when air is admitted sand is elevated into storage tanks which are located on coal chute.

COALING STATION.

This structure is built of structural steel with corrugated iron roof and sides and concrete pits and foundation. It has storage bins of 1,000 tons capacity, seven 20-ton scale hollers, three 10 cubic feet dry sand storage tanks, two continuous conveyors which handle 75 tons of coal per hour, and driven by 35 H. P., 440-volt, 3-phase, 60-cycle motors. There are also four feeders which feed the coal from track hoppers to crushers which are driven by 5 H. P., 440-volt, 3-phase, 60-cycle motors. It also



Layout of Terminal as Air Line Junction (Continued).

has four track hoppers served by two tracks, equipped with two coal crushers, driven by 25 H. P., 440-volt, 3-phase, 60-cycle motors. Engines can receive coal or sand from seven different tracks. The machinery was manufactured by the C. W. Hunt Co., and the station was built by the Phillips-Lang & Co.

CINDER PITS.

The cinder pits are of the L. S. & M. S. standard, double track, open side type, with depressed tracks between, one 200-foot pit and 40-foot pit being located at each engine house. Space has been provided for extending the 40-foot pit to 200-foot long. There is also a 200-foot pit provided adjacent to classification yards. This pit is used for handling yard engines and through freight engines which are not required to be brought into engine houses. The pits are constructed of concrete lined with vitrified paving block, the outer rails being supported on concrete walls and inner rail supported on "I" beams and cast iron chairs. The floors of pits are sloped $\frac{3}{16}$ inch in 12 feet so that water will run off easily. Suitable catch basins for water have been provided for at ends of pits.

CINDER PIT TOOL HOUSE.

This building is located adjacent to cinder pits and is constructed of concrete and brick with wooden roof. It is divided into three compartments, one for locker and service room for cinder pit men, the other two for storage of tools, etc., taken from engines at cinder pit. The building is heated by high pressure steam through pipe coils.

HOSTLERS' BUILDING.

This building is located adjacent to coaling station and constructed of concrete and brick with wooden roof. It is used for hostlers' lockers and service room. The building is heated by high pressure steam through pipe coils.

WATER SYSTEM.

Two 100,000-gallon water tanks 30 feet in diameter by 24 feet high are provided at engine houses, penstocks are provided near coaling station and also on outgoing engine tracks. Ample fire protection has been provided for in all buildings and throughout yards.

Freight Car Repair Shops and Yards for Repairing Wooden Cars.

This group consists of a heavy car repair shop, wood mill, machine shop, blacksmith shop, brake beam shop, dry lumber shed, storehouse, including oil room, also an office on second floor; building including paint, tool, tin and oil rooms, air brake shop, mess and toilet room in repair yards, general toilet building, finished material shed, power house, light repair yard, lumber storage, bad order car storage, etc.

CAR SHOP.

This building is 243 feet wide by 441 feet 3 inches long and 23 feet to top of crane rail. It is constructed of concrete, brick and steel; the roof construction is of the monitor type, thus affording excellent light in all parts of shop. Steel sash is used throughout. There are 12 repair tracks with standard gauge industrial track between every pair of tracks. These industrial tracks connect with all the other shops in group by means of turntables. Three twenty-ton cranes are provided in this schop for general service. Cranes are manufactured by the Cleveland Crane & Engineering Co.

WOOD MILL.

This building is 61 feet 6 inches wide by 163 feet 2 inches long. Foundations are of concrete, walls of brick, roof trusses of steel and floor of wood. A wide monitor extends the entire length of roof and has windows on both sides. Following is the list of tools which are in this shop:

One 14 by 20-inch planer and matcher, one 4-side 12 by 18-inch planer; one 42-inch band saw; one 36-inch cutoff saw, one 16-inch jointer, one 24-inch by 4-foot planer, one 20-inch wood turning

lathe, one 36-inch swing cutoff saw, one extra range heavy auto car gainer, one comb vertical and radial car borer—5 spindle, 3 vertical and 2 radial, 1 band, rip and re-sawing machine—capacity 24 inches wide, 12 inches thick.

MACHINE SHOP.

This building is 61 feet 2 inches wide by 91 feet 2 inches long; foundations are of concrete, walls of brick, floor of wood and roof truses of steel. A wide monitor extends over roof, having windows on both sides. Industrial tracks are brought in this shop close to journal lathes, so that wheels and axles may be handled with least possible movement. A 6-inch 12¼-pound I-beam for trolley is also provided for the unloading of material which comes from blacksmith shop.

Following is the list of tools which are in this shop:

2 36-inch drill presses.
1 32-inch drill press.
2 1½-inch triple head bolt cutters.
1 2-inch single head bolt cutters.
1 24-inch shaper.
1 3 by 16-inch emery wheel.
1 double journal turdning lathe.
1 6-spindle nut tapper.
1 18-inch by 8-foot engine lathe.

BLACKSMITH SHOP.

This building is 71 feet 10 inches wide by 127 feet 6 inches long. Foundations are of concrete, walls of brick, and cinder floor, and roof trusses are of steel. A wide monitor extends over roof having windows on both sides. A 22-inch jib crane is provided to serve the 1,500-pound steam hammer.

Following is the list of individual motor driven tools which are in this shop:

12 300-pound anvils.
12 5-foot forges.
1 combination punch and shear, 36-inch shear end and 48-inch punch end.
1 friction saw, capacity 15-inch I-beam or its equivalent.
16 by 10-foot furnace.
1 4 by 8-foot furnace.
1 1,500-pound steam hammer.
1 200-pound Bradley hammer.
2 6 by 10-foot face plates.
1 punch, 21-inch throat.
1 3 by 16-inch electric driven emery wheel.
1 pressure blower, 4,000 cubic feet of air per minute.

BRAKE BEAM SHOP.

The construction of this shop is similar to the blacksmith shop. It is used for repairing steel brake beams of all kinds. Coupler yokes are also taken off and applied here.

Following is the list of tools which are in this shop:

1 iron shear.
6 5-foot forges.
1 3 by 7 by 4-foot double end furnace.
1 coupler pocket press.
1 24-inch drill press with sliding head.
6 300-pounds anvils.
1 pressure blower, 4,000 cubic feet of air per minute.
1 3 by 16-inch emery wheel.

DRY LUMBER SHED.

This building is a frame structure 50 feet wide by 160 feet long with concrete foundation. The roof is of the shed type with monitor extending full length of building. On one side of this building is located a door shop 15 feet wide by 69 feet 10 inches long in which car doors are repaired.

Following is the list of tools which are in this shop:

1 2spindle horizontal boring machine.
1 No. 3 self-feed rip saw.
1 16-inch cutoff saw.
1 24-foot cutoff saw.

STOREHOUSE, OFFICE AND OIL ROOM.

This building is 47 feet 2 inches wide by 318 feet 10 inches long. It is constructed of concrete and brick and has a shed type roof. On one end of building is a second floor on which is located the general foreman of shops and his assistants, also file and record rooms. In the other end of the building there is an oil room 15 feet 9½ inches wide by 45 feet long, in which is stored barreled oil and baled waste.

A 12-foot receiving platform is provided on one-side of building and an 8-foot delivery platform on the other side; also large storage platforms at each end of building. The platforms and first floor of building are 4 feet above top of rail. Platforms and floor are composed of 4½ inches of concrete covered with 1½ inches mastic finish.

PAINT, TOOL, TIN AND OIL ROOM.

This building is 32 feet 2 inches wide by 141 feet 2 inches long. Foundations are of concrete, walls of brick, roof is constructed of 8-inch "I" beams covered with concrete slab and composition roofing. Floors are of 2-inch yellow pine, except oil rooms and paint rooms, which are cement. Nine-inch walls divide off the rooms. Each room is entered by outside doors.

AIR BRAKE SHOP.

This building is 27 feet 2 inches wide by 37 feet 2 inches long. Foundations are of concrete, walls of brick, roof trusses of wood, floor of 2-inch yellow pine. This shop is equipped with one improved M. C. B. standard triple valve test rack and one 3-inch pipe cutting and threading machine.

MESS AND TOILET ROOM FOR REPAIR YARD.

This building is 25 feet wide by 225 fcet 9 inches long. Foundations are of concrete, walls of brick, roof of 12-inch "I" beams covered with concrete slab and composition roofing. Floor is 4½-inch concrete slab with 1½-inch smooth finish. The toilet room occupies a space of 25 feet by 36 feet and has a 5-foot basement under entire room. This basement is used for access to pipes and traps. In this building are suitable tables, benches, lockers and toilets to accommodate 314 men.

The general toilet building is 25 feet wide by 62 feet 2 inches long and is similar in construction to mess and toilet room in repair yard. It has toilet facilities to accommodate about 400 men.

POWER HOUSE.

This building is 41 feet 4 inches wide by 42 feet 2 inches long, and is of the same general construction as machine shop. This equipment consists of one 210 H. P. locomotive type boiler, one open type feed water heater, two feed pumps and one Ingersoll-Rand 1,500 cubic foot air compressor driven by a Westinghouse Company's self-starting 249 H. P., 4,000-volt, 3-phase, 25-cycle synchronous motor mounted on main shaft of machine, an after-cooler and storage tanks for air are located outside of power house; natural draft is obtained by a 3-foot 6-inch diameter by 80-foot steel stack. Space is provided in power house for an additional future boiler.

LIGHT REPAIR YARD.

This yard is located adjacent to repair buildings and has a capacity of 370 cars; each pair of tracks are served by an industrial track which is connected with repair buildings by means of turntables. There is also bad order storage yards located adjacent to repair yards which have a capacity of 387 cars.

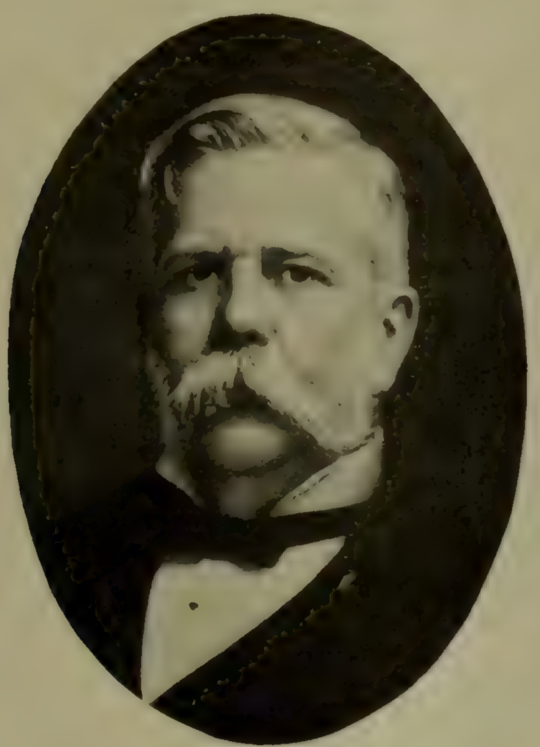
HEATING AND LIGHTING.

The car shop buildings are heated by direct radiators using high pressure steam and pipe coil radiators; a loop return system is carried to a vacuum pump which is located in power house. The brake beam shop, blacksmith shop and dry lumber shed are not equipped with steam heat.

The shops and yards are illuminated by Mazda lamps with Holophane reflectors; suitable plug boxes for hand extensions are also provided along columns and walls in the various buildings.

GEORGE WESTINGHOUSE

George Westinghouse, inventor and engineer, died of heart disease at his New York City residence on Thursday, March 12. His health had been failing for some time and consequently his death was in a measure anticipated. Mr. Westinghouse was born at Central Bridge, Scholarie County, N. Y., on October 6, 1846. The father's ancestors came from Germany and settled in Massachusetts and Vermont before the Revolution; the mother's were Dutch-English. Before he was fifteen he invented and made a rotary engine, and at an early age passed the examination for the position of assistant engineer in the United States Navy. In June, 1863, though barely seventeen, he enlisted in the Twelfth New York National Guard. Shortly afterward he accepted an appointment as third assistant engineer, United States Navy. On his return from the war he entered Union College, where he remained until the close of his sophomore year, and, obedient to his impulse for experiment, abandoned his classical studies and entered upon active life, to find a wider scope for his inventive genius. In 1865 he invented a device for replacing railroad cars upon the track, which, being of cast steel, was manufactured by the Bessemer Steel Works, at Troy, N. Y.



GEORGE WESTINGHOUSE.

Going to Troy one day, a delay caused by a collision between two freight trains, suggested to Mr. Westinghouse the idea that a brake under the control of an engineer might have prevented the accident. His first thought was an automatic brake attached to the couplers, which was unsuccessful. This was followed by steam, which proved also to be unsatisfactory because by the time it reached the brake from the engineer's cab it lost its power. At this point Fate seems to have entered his life. In the pages of a magazine he had subscribed to through the solicitation of a young girl, he saw an account of the use of compressed air in digging the Mount Cenis tunnel, three thousand feet under ground. Instantly the inventor saw the light.

He began to think over the matter, and, after much further study and investigation, the use of compressed air impressed itself on him. Drawings of the air-pump, brake cylinder and valves were made, but considerable time elapsed before a practical trial of the brake was obtained. The first patent was issued April 13, 1869, and the Westinghouse Air Brake Company was formed on the 20th of July following.

During the next few years Mr. Westinghouse invented the "automatic" feature of the brake, which overcame the imperfections in the first form, and removed the danger from the parting of trains on steep grades. In 1886, he invented the "quick-action" brake, the improvement being made in what is known as the "triple-valve." The automatic and quick-action brakes are regarded by experts as surpassing the original brake in ingenuity and inventive genius, being not mere improvements, but distinct inventions of the highest class, unique and remarkable.

About 1880, Mr. Westinghouse became interested in the operation of railway signals and switches by compressed air, and soon after there was developed and patented the system now manufactured by the Union Switch & Signal Company.

In 1886 the Westinghouse Electric Company was formed for the manufacture of lamps and electric lighting apparatus, Mr. Westinghouse having become interested in the subject. The business rapidly developed and in 1889 and 1890 this company absorbed the United States Electric Company and the Consolidated Electric Light Company. In 1891 all these properties were reorganized into the Westinghouse Electric & Manufacturing Company. In 1892, Mr. Westinghouse secured for the electric company the contract for the electric equipment of the World's Fair at Chicago, and in 1893 the contract for the large generators at Niagara Falls, both of which marked epochs in the progress of the electrical industry.

The question of the steam turbine and its applications was investigated by Mr. Westinghouse and he secured the patent rights of Chas. A. Parsons of England on the turbine in 1897-98. This development of a new prime mover soon led the inventor to consider the use of the turbine as a prime mover for ships. The trouble was the high speed. Mr. Westinghouse then developed and brought out one of the most ingenious of modern mechanical engineering. This was the mechanical reduction gear for reducing the inherently high speed of a turbine to the slow speed of a ship propeller or direct current dynamo. He accomplished this work in collaboration with the late Admiral Geo. W. Melville, U. S. N., and John H. MacAlpine. Within the last few years he also occupied himself with the development of an air spring for automobiles and motor trucks, which rapidly came into favor.

It is simply stating a simple fact to say that Mr. Westinghouse has been a great factor in the advance of civilization as represented by the important part he has played by introducing improved means of transportation. Chance has had no place in the success of this man. It was due to his foresight, courage and technical skill. As with his first invention, the air brake, the different kinds of apparatus were developed to answer actual needs, in some cases acknowledged generally, and in others foreseen by him. When the apparatus had passed the experimental state and was ready for commercial exploitation, he established factories which are themselves models.

Owing to his many achievements in merchanics, electricity, steam and gas, his name was known the world over, and he had many honorable distinctions conferred upon him for his achievements and in recognition of the services he rendered the various branches of engineering. His alma mater, Union College of Schenectady, conferred upon him the degree of doctor of philosophy. He was decorated with the order of the Legion of Honor, with the order of the Royal Crown of Italy, with the order of Leopold of Belgium. He was the second recipient of the John Fritz medal. He received the degree of doctor of engineering from the Koenigliche Technische Hochschule of Berlin, Germany. He was an honorary member of the American Society of Mechanical Engineers, of which body he was also president in 1910. He was one of the honorary members of the American Society for the Advancement of Science. He was an honorary member of the National Electric Light Association of America. He was awarded the Scott premium and medal by the Franklin Institute of the State of Pennsylvania. He received the Edison gold medal for meritorious achievements in the alternating current system of electrical distribution. He received the Grashof gold medal from the Society of German Engineers in Germany, which acknowledged him the greatest American engineer.

Mr. Westinghouse was connected with a large number of industries at home and abroad, many of which bore his name.

The Westinghouse companies employ 50,000 men, on whom 150,000 persons are dependent. The total capitalization of all the companies is $200,000,000.

Mr. Westinghouse was married August 8, 1867, at Brooklyn, N. Y., to Marguerite Franklin Walker. They had one son, George, who is a graduate of Yale, and was recently married to the Honorable Evelyn Violet Brocklebank. His wife and son survive him.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.

The Niagara Frontier Car Men's Association is the name of a new organization in the railroad world. There are over a hundred railroad men in the organization, and the object of the association is to bring together those interested in car department matters for the purpose of exchanging ideas and educating the car men to a keener knowledge of economy in maintenance of equipment and for the settlement of disputes.

The officers are as follows: president, W. H. Sitterly; first vice-president, W. B. Shone; second vice-president, J. McCormick; secretary, E. N. Frankenberger; treasurer, C. J. Charlton. The following comprise the board of directors: B., R. & P., C. Hildebrand; Buffalo & Susquehanna, W. Monan; D., L. & W., G. J. Charlton; Erie, T. Tracy, M. Meehan; Grand Trunk and Wabash, D. C. Messeroll, S. Warren; L. S. & M. S., A. G. Berg; Lehigh Valley, J. Deibert, J. McCormick; Pennsylvania, W. H. Sitterly; N. Y. C. & H. R., A. Faerber, J. Muhlbauer, W. Shone; N. Y. C. & St. L., J. Gordon; Mich. Central, E. Howe, J. Balwdin; Pere Marq., G. J. Charlton, J. Muhlbauer; H. Fryer; P. Bach; W. Krantz; J. Schmidt; H. Yaeger.

Committee on subjects: J. Schaeffer, A. Berg, H. H. Fyer.

Committee on introduction and welcome: F. Cleary, J. M. Gietzen, A. J. Krueger.

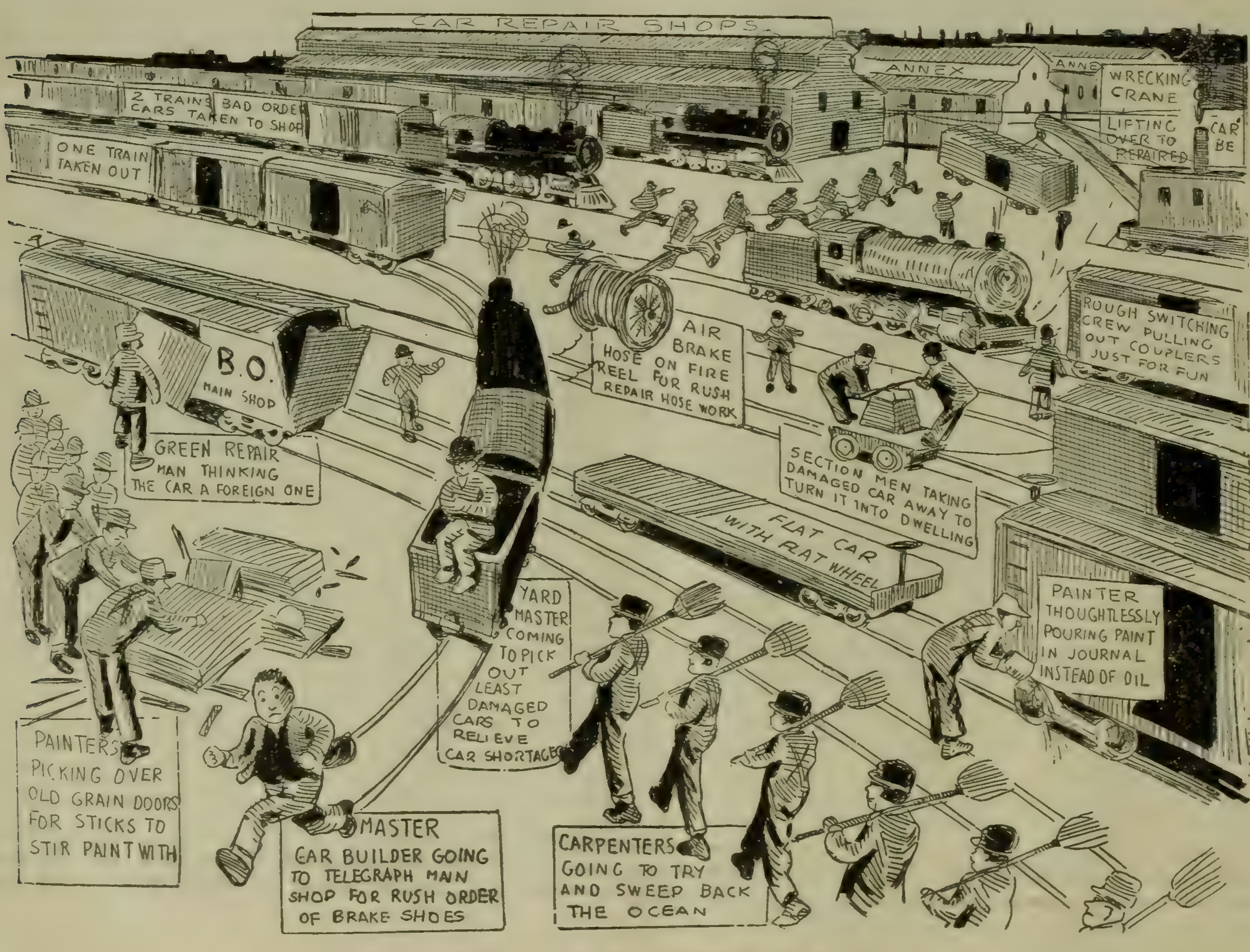
Auditing committee: M. Shreenan, F. J. Fennell, J. C. Schmidt.

Committee on publicity and membership: F. J. Fennell, A. J. Krueger, W. B. Shone.

THE NEW YORK RAILROAD CLUB on Friday, March 20, held its tenth annual electrical night. The feature of the evening was a paper on "Swiss Electrification," by Emil Huber-Stockar, permanent consulting engineer on electrification of the Swiss Federal Railways. He reviewed the development of electric traction in Switzerland, from the first electrification in 1894, to date. The last large work was the 15,000-volt single-phase electrification of the Lötschberg Railway. Mr. Huber said that the commission had recommended the single-phase system, although the costs of the three systems did not vary greatly. Other speakers were George Gibbs, consulting engineer, Pennsylvania R. R.; A. H. Armstrong, General Electric Co.; W. S. Murray, consulting engineer, New York, New Haven & Hartford R. R., and N. W. Storer, Westinghouse Electric & Manufacturing Co.

BOMBAY, INDIA, is considering the electrification of the railways in the city and suburbs. Mr. Merz, who made a report on the electrification of the Melbourne, Australia, railways, has prepared a report on the Bombay situation, which is altogether in favor of electrification. The report estimates that the electric trains could be driven at 20 per cent higher speed than steam trains.

H. W. ENSIGN has been appointed master mechanic of the Chicago Great Western at Clarion, Ia., succeeding John R. Thompson.



The Car Repair Shop as the Cartoonist Sees It.

PAST AND PRESENT RAILROADING.*

By Hon. Orville F. Berry, Examiner Attorney, Interstate Commerce Commission, Washington, D. C.

In this busy age in which we live it is well for us sometimes to pause and turn our eyes backward and review briefly, at least for present use, the past. One of the greatest enterprises and interests in the world today, in business lines, is the railroads of the country. The subject I have chosen—past and present railroading—in its very nature, must take the form of past history and present operation.

Railroads had their origin in tramways over 200 years ago in the mining districts of England, and were used to convey coal to the seaboard with animal motive power. It was discovered in 1814 that a smooth wheel would adhere to a smooth rail, thus making it possible to consider the use of the tractive power of a rolling locomotive. Hence its necessity, and it is said truly that necessity is the mother of invention. Thus, soon after, followed the trial trip of the "Rocket" in 1829, which may with reasonable certainty be described as the first successful steam locomotive.

While railroads of different character existed in this country, the Baltimore & Ohio was the pioneer American railroad built for public use and of any practical value. On July 4, 1828, the first rail of this road was laid by the Honorable Chas. Carroll, the only surviving signer of the Declaration of Independence at that time, and thirteen miles of this road was open for traffic in 1830. The same year the West Point foundry began building locomotives and soon produced the well-known "DeWitt Clinton." It weighed 3½ tons, and was built for the Mohawk & Hudson River, the pioneer company and beginning of the present New York Central Lines, which had been chartered in 1826.

This line was opened for use from Albany to Utica in 1836, and to Buffalo in 1842. Connections rapidly followed to New York and Boston.

About this time in Pennsylvania the Columbia Railroad was built from Philadelphia to Columbia, which was the pioneer division of the present great Pennsylvania System.

Following the panic of 1837 little development was made in railroad construction or operation. In 1850 began the era of rapid extension of railroads and the welding together of short connecting lines under a single ownership. Strange as it may seem, consolidation of railroads was as vigorously opposed at that time as it has been in later years. Originally there were eleven companies interested in and operating the line between Albany and Buffalo. Between Buffalo and Cleveland changes of passengers and freight were made at both Dunkirk and Erie. This, indeed, would seem a strange proceeding at this time. We are sometimes compelled to change passengers and freight from one train to another in times of storm and even then it is so inconvenient that most of us lose our patience.

This change at that time was made necessary by the difference in gauge of the two divisions, one being six feet the other 4 feet 10 inches. Very properly, plans for the consolidation of these lines for through operation were undertaken to be made to obviate this transfer. The proposition so aroused the indignation of the people of Erie that they resorted to violence. And in December, 1853, they tore down the railroad bridge so that no trains were sent through until February, 1854. This bridge was rebuilt and again torn down by a mob. Finally a compromise was made which ended what was known at that time as the "Erie War," and the gauge was changed for through operation.

In 1851, the Erie Railroad joined New York with Lake Erie. The Baltimore & Ohio reached the Ohio River. Two years later connected the Atlantic Seaboard and Chicago, and the following year reached the Mississippi. These extensions to what was then the western frontier, opened traffic for the first time between the Ohio and the Mississippi Rivers.

*A paper read before St. Louis Railway Club.

In these early days there was a great public desire for rail trnsportation and the public was willing to furnish financial support, but so much trouble had occurred and antagonism aroused in places, that some of the States passed laws prohibiting assistance. When the Louisville & Nashville was built, Cincinnati desired an outlet to the South, but the law above referred to prohibited them from giving assistance, and a scheme was devised by which a line was built, owned and operated by it; later leased to the Cincinnati, New Orleans & Texas Pacific.

Railroads and railroad transportation were important factors in the conduct and carrying on of the Civil war. Great damage was done to many lines in the South on account of military operations, and until after the close of the war no pronounced advance in protection by appliances employed in the control of train operation was made.

The first Pacific Railroad was begun with government aid in the '60s. Thus began the opening up of the West beyond the Mississippi River, and the return to industrial pursuits of the people after the war marks a remarkable era and period in railroad building. During the ten years beginning with 1880, 70,000 miles of railroad were built in the central and western territory, thus opening up vast heretofore unoccupied agricultural, grazing and mineral sections for development. But again in 1893 the panic practically stopped the extension of railroads and the period since 1900 has been more a period of reconstruction and improving existing lines. the growth of industries, the increase of population along present lines of railroad than otherwise.

The importance and magnitude of the railroad business will be better understood by us all when I tell you that about 20 per cent of the capital of the United States is invested in railroads. Nothing can be much more interesting to any individual, and especially to the railroad man, than the continuous growth by years or periods of railroads. In 1830 we had 23 miles of railroad; in 1840, 2,800; in 1850, 9,000; in 1869, 30,600; in 1870, 53,000; in 1880, 93,000; in 1890, 163,500; in 1900, 193,000; in 1914, about 300,000.

A careful study of these figures will give us a mountain-top vision of railroad growth and its value and importance today. It would be interesting and profitable, if time allowed, to study the history of our country in all other lines, showing its gradual growth with the development of the railroad, and such study will convince any intelligent man that railroads have been one, if not the one, greatest element in the development of our country along all kinds of business development, and to that may be added the development of schools, churches and colleges which have rapidly followed the advancing line of railroads westward.

May we now go back and look at some of the specific improvements and their growth in connection with the operation and management and convenience of railroads and railroading. As the density of traffic increased the demand naturally followed for more speed, and that fact required greater weight in equipment. This followed very rapidly and the first apparent need was for more efficient brakes or means of controlling the train, and that it should be simultaneously applied and from a single point of control if possible.

In 1869, George Westinghouse, Jr., presented what is known as the "Straight Air Brake." These brakes proved, however, unsuccessful and useless, for the reason that a break in the air line made them useless. With this and other shortcomings of that particular brake the automatic air brake was produced in 1873. With the application of this air brake to freight cars it was found the reduction of pressure was not quick enough to set the rear brakes and accidents followed from bunching of cars. But American genius was still at work, and about 1886 witnessed the introduction of the Westinghouse quick action air brake, which has continued from that time to this, with many features of improvements and is very successful today.

This apparent means of control emphasized the necessity of

some better coupling device, all railroad men realizing that the coupling and uncoupling of cars involved the all-important questions of interchange and safety. In view of many difficulties and accidents, F. B. Adams, of the Boston & Albany Railroad, recommended to the Master Car Builders' Association at its convention in 1869 that a uniform height should be established for couplers. At the convention of the same association in 1873 a committee on that subject pronounced the automatic couplers a failure. Another committee at the same convention gave recognition to automatic couplers by reporting that a great advantage would be derived from the use of a uniform drawbar, such as would be accepted as a standard and which would be a self-coupler.

In 1885, public tests of couplers were made at Buffalo. Forty-two couplers were tested, only 12 of which were recommended for further test. In 1887, the executive committee of the Master Car Builders' Association reported in favor of the Janney type of coupler. This report was adopted in 1888. At the convention in 1889 action was taken on this subject, making this type standard and it has been so regarded since and called "Master Car Builders' Coupler."

In 1893, Congress enacted a law requiring all railroads engaged in interstate commerce to provide all cars and locomotives with continuous power brakes capable of being controlled by the engineman in the locomotive cab, and also to use automatic couplers, so that today we practically have a uniformity in height and contour such as to insure perfect contact between all classes of equipment. The design and attachment to car bodies are prescribed of a strength in excess of the power of locomotive in modern friction draft gear, the strength of which reaches 250,000 lbs. This branch of operation having been reasonably well settled, the next improvement that would naturally be considered would be signaling.

The need of indicating the condition of the road to trains came naturally with increase of traffic and speed. As these conditions developed in England before they did here, the first step along that line was taken there. In 1834, the Liverpool & Manchester Railroad introduced the first system of mixed signals consisting of an upright post with a rotating disc at its top, showing red for danger, and the absence of indicating by day and a white light by night for clear. This being the foundation or start, many improvements have been made along this line. Many demonstrations have been made and tested, many have failed of successful approval and many have been adopted and have proven very successful. Until about 1841 there was no communication between stations. Each signal man displaying his signal at danger after the passage of a train until a certain time had elapsed, when it was clear, and the only information conveyed to the engineer was that the preceding train had been gone from the station a certain length of time.

The failure to act with sufficient promptness at the display of danger position and the many collisions that followed, led to the installation of additional signals to give advance information to the engineer.

Thus we have here clearly outlined the first thought of the present block signal.

Making use of the telegraph, the chief engineer of the United New Jersey Canal & Railroad Co. devised and installed in 1864 the first block signal system in this country, on the double track line between Philadelphia and New Brunswick. The signal itself was a white board by day and a white light by night, indicating clear. For the danger indication, a red screen fell to cover the white board or light. Notwithstanding numerous improvements in apparatus the same practice of fixing a positive space interval, by means of communication between block stations, still holds good, and one of the important subjects now being discussed and perfected by railroad experts is signaling.

Following in natural sequence, the next subject of importance would be interlocking, developing naturally along the same lines of manual operation of signals, and as a further safeguard against mistakes interlocking grew up as a means for preventing conflicting signals being given at the same time. As with signals, so with interlocking, England led us. The first plan of interlocking adopted was where the entire control fell to one man, so located as to be in touch with the whole situation and equipped with a machine that would not permit of setting up conflicting routes. Railroads were prompt to see this advantage and in a short time many similar machines were put in operation. In 1876, the first power-operated interlocking system was perfected, which was the pneumatic type. In 1900, an all-electric interlocking machine was put in operation and has proved reasonably successful.

The more recent development of power-operated interlocking systems, with complete electric indication of the condition of all tracks, has made it possible for larger systems to be consolidated under the control of a central plant, and under the direction of one authority. These machines are being used largely and very satisfactorily.

With this increase of equipment and manner of control, it is not strange that railroad men at once began to devise some plan of train dispatching, and the first departure from the old-time interval and flagging method of operation of trains came in 1851. The New York & Erie Railroad established a line of telegraph between some of its stations for company business. And again we find necessity the mother of invention.

The superintendent of telegraph of this railroad and the division superintendent were together at the Elmira depot and learned that the west-bound express from New York was four hours late (it is well to note that it is not only in modern times that railroad trains are late); the superintendent of telegraph had information that at Corning an east-bound stock train and a west-bound freight at Elmira were waiting for the express, and he suggested that the freight train at Elmira could be sent to Corning and the stock train at that point ordered to Elmira with perfect safety before the coming of the express. The move was successful and very much encouraged similar operations, and this, indeed, is the beginning of train dispatching. Its adoption over the entire line of road followed, in spite of the opposition that the general superintendent met when planning for its introduction, and many conductors and engineers resigned rather than operate a train on telegraphic orders against the time of another train. In later years experiments have been made in train dispatching by telephone. The investigations that I have made along this line lead me to believe that there is a great difference of opinion among railroad people on that subject.

Having briefly noted the growth of operation along certain lines of railroading, may we now turn to the equipment itself, and notice its growth. As early as 1680 Sir Isaac Newton predicted steam-propelled carriages, and through the eighteenth century several types of steam vehicles appeared, but they were considered curiosities. Some of them, as we study their form and makeup, indicate the locomotive, others the modern automobile, but not until 1803 was anything really deserving the name "locomotive" built. Richard Treverick, a Cornish miner, constructed a locomotive bearing his name, and strange to say it was the result of a bet.

On the trial, this machine, or locomotive so-called, conveyed ten tons of iron nine miles on a cast iron tramway by steam power, and he won his bet. The desire of other mine owners to use steam motive power was so strong that it led to the practical demonstration of adhesion, which is so necessary in such operation. On this principle Wm. Hedley built his "Puffing Billy," a complicated affair composed mostly of levers, beams and gears.

On the completion of the Liverpool & Manchester Railroad the directors were undecided as to what kind of power they would use, and they offered a prize of £500 for a locomotive moved by steam that would fulfill certain conditions named. The test came in October, 1829, on a level piece of track about

1½ miles long, between four competitors. Stevenson's "Rocket" won, and gave the world the mechanical combinations largely represented in locomotives until this day.

American locomotive practice and building almost universally followed the Stevenson model. The four-wheel engines of the English type proved injurious to the light rails and sharp curves on our early roads, and to overcome this John B. Jervis, chief engineer of the Mohawk & Hudson Railroad, introduced the four-wheel "Bogie" truck. For some twenty years this design remained, until in the '50s. The demand came for more tractive power. This brought about the addition of another pair of coupled drivers,—thus evolving the well-known American type of locomotive. Between the years 1880 and 1890 more drivers were added and the ten-wheel type began to be used in high-speed service. This was followed in about 1895 by what is known as the Atlantic type.

The Pacific type, or the most modern high-speed locomotive, is a development of this idea. In 1888 Mallet designed the articulated locomotive, and in 1904 the first one of this type was placed in operation on American roads, and it has gained in favor where maximum tractive power on heavy grades is required. It is well to remember that in no branch of art or industry has there been greater improvement, both practical and artistic, than has been made in the development of the railroad locomotives, and today we stand in the presence of one of these mighty machines and admire not only its beauty and power, but almost seeming intelligence, and when we realize its mighty power and that its entire operation and usefulness depend upon the man who holds the throttle, we unconsciously take off our hat to the engineman.

With the growth of the engine, naturally the problem of car construction must accompany it, and a careful examination of the history of the railroad car shows it moved along readily, step by step, with the development of the locomotive. The increase in length of passenger cars with corresponding increases in weight led in the year 1880 to the almost general employment of a six-wheel truck instead of four, and even eight-wheel trucks were used for a time, but finally rejected on account of the excessive length of wheel base and other complications. Great interest attaches at this time to the manufacture of solid steel-forged wheels, as well as all-steel cars, and today most of our best vestibule trains may be said to be in reality a "parlor on wheels." Following car construction comes car heating, both for comfort and convenience of the passengers. The original method was with stoves, which were not only a discomfort, but a great danger in case of accident.

The next step above that was the hot-water heater, which was an improvement, but still left the danger of fire. But today the growth and capacity of the steam boiler and the perfection of the couplings has led to the present practice of steam heating cars, which is very satisfactory and apparently safe.

A well-built and well-heated car would be useless in this day without proper lighting. Car lighting has passed through the identical stages of growth that house lighting has passed through, and has improved as rapidly until today most of our trains are as well lighted as the modern home.

Thus far we have considered almost entirely railroad equipment or its control. In view of our great lines of railroad today, crossing the entire continent, and having overcome both rivers and mountains, it is well to remember some of the facts in connection with this branch of progress in railroads, for in this as in no other department of railroading do we see the ability and courage of the railroad engineer. In bridge construction for centuries the simple beam or arch were the only spans employed. The construction of railroad bridges requires something more than either of these, and today we find the great railroad bridges with truss construction, enabling the railroads to bridge streams and secure continuous roadway.

It was very interesting to me in looking up this history to find that the first railroad bridge was built across the Mississippi River at Rock Island in 1856. And still stranger it appears that it had hardly been completed at great expense before St. Louis steamboat interests demanded its removal as an obstruction to navigation, and stranger still the United States District Court found it was an obstruction and ordered its removal within six months. The judge, in his opinion, among other things, stated: "If one railroad is able to transfer freight and passengers without delay and expense of changing at the river, financial necessity will compel competing roads to provide themselves with the same facilities." Which evidently led him to see in the far distant future the ruination of all traffic. It is still interesting to know that this case was appealed to the United States Supreme Court and that Abraham Lincoln was attorney for the Railroad Bridge Company. He argued that both river and railroads were great highways for people, and while at that time the traffic on the river was possibly greater than on the railroad, he predicted with that foresight that so marked his entire life, that the time might come when the railroad would carry as much traffic as the river. Therefore, he urged that they should be entitled to equal consideration, and the Supreme Court took that view of the case and the bridge remained.

Such an argument would seem very strange now, and yet it only emphasizes the great growth and the great difference between past and present railroading and railroad ideas.

I might with profit, if time would permit, discuss the improvement, which is equally interesting and rapid, of the rail upon which these locomotives and cars run. The most interesting fact that comes to us in the study of the development of the rail is the very simple changes that were necessary and how a little thing properly used becomes so very important, and it is sufficient to say that our rails, rail fastenings, ties and ballast have kept pace with all other developments of railroading. The general demand made upon railroads by the public and by railroad officials and employes as well for "safety first" will necessarily sooner or later, and we hope sooner, bring about the abolition of grade crossings, the trespassing upon railroads and the abandonment in a large measure of all wooden cars for passengers.

Notwithstanding the great improvement in all equipment, including roadbed, track, bridges, signals, etc., the human element necessarily is the most important element in its operation. And with a view of raising the standard along these lines and improving individual service, a system of physical and mental examination has been adopted by practically all the roads. In the early days of railroading, the individual service was much less definitely classified and the exactions much less than they are under modern conditions. In keeping with the progress of mechanical and other safety devices the necessity of a better system of training for the employes has become apparent. Employes must pass an examination today as to vision, color and hearing, and their general knowledge of the fundamental rules and regulations as well as a general knowledge of the road, safety appliances and other equipment. These examinations conducted from time to time, my information leads me to say, after talking with the management of the road and the employes, are satisfactory, necessary and meet the approval of all. Some of the larger roads are establishing schools of instruction for their employes, where they may fit themselves, not only to better perform their present duties, but put themselves in line for promotion. The great need today among the employes of railroads is to feel their great responsibility and to realize fully the great value of both property and life that is entrusted to their care. My experience as railroad commissioner has led me to believe, and I say without any reservation, that the railroad operation of today is equal, if not superior, to any other business in its management, and that there cannot be found in this country, in any other business, more capable and conscientious men than are found in every department of the railroad operation, yet it should be remembered that the entire system of operation is only as strong and as safe as the weakest place in that organization or the most

unreliable employe. In other words, no chain is any stronger or of more value than the weakest link in that chain. Therefore the importance to the public of careful and conscientious employes in every department of its operation.

I trust that this brief study of past and present railroads and railroading may be as profitable to each one of you as the study of it has been to me. Its growth and present importance is such as to inspire enthusiasm in every person connected with it, and we should all feel that we are a part of the great organization whose work relates in a very large measure to the public good, and that while there is a large number of people engaged in such operation and connected with the railroad, that fact does not lessen the personal responsibility of every individual, but rather increases it.

From a few miles of tramways the world has in a century built 500,000 miles of steam-operated and 100,000 miles of electric-operated railroads. Instead of the old manner of operating we have the modern. Instead of the old-fashioned train we now have the huge Pacific locomotive drawing a train of 600 tons at a speed of 70 miles per hour, yet under the control of one man, just as the "Rocket" was a century ago. Instead of the old manner of stopping, or rather failure to stop, we now have the air brakes that make stopping a certainty in a definite distance. Progress of a most pronounced kind has occurred during the last century. What the future of railroading may be I do not undertake to say. I believe, however, it is high time that special consideration was given to this great industry and that it should be encouraged from every possible standpoint.

Wherein the increased safety of operation may lie is a question in many minds. It would be a mere conjecture if I were to attempt to explain it. Let us beware, however, that the multiplication of rules with so many devices for additional protection does not lead us to rely on a false sense of security.

None of these devices alone will bring safety. They may materially aid it, but unless there is an obedience to the rules of operation they will add but little to the safety of the public.

My association with men in every department of railroading has convinced me that we owe much of the speed, comfort and convenience of travel to the men who not only guide its general movements, but also to the men who directly operate the trains and to the men who keep the track and equipment in proper order.

HEAT-TREATED CHROME-VANADIUM STEEL TIRES.

Progress reports from two roads which are testing heat-treated chrome-vanadium steel tires have recently been received, and also records to date of one of the first sets of vanadium steel tires made, which have been in service over four years. These records are given below:

Three sets of heat-treated chrome-vanadium steel switch engine tires were purchased last year by the Chicago, Rock Island & Pacific for test purposes. In the early part of February of this year contours were taken of two sets, on engines No. 196 and No. 1224, respectively. The first mentioned were applied in April, and the latter in July of last year. Contours were also taken of two sets of plain carbon steel tires on the same class of switchers and in their first term of service.

A comparison of the performance to date of the vanadium steel tires on locomotive No. 196 and one of the sets of plain carbon steel tires, which went into service at practically the same time, shows 93 per cent increase in mileage per 1/16 in. maximum tread wear in favor of the vanadium tires.

Up to the first of February the vanadium tires had made 22,084 constructive miles. They showed a maximum tread wear of 5/32 in. This gives 8,830 miles per 1/16 in. maximum tread wear. Up to the same period the carbon steel tires had made 16,000 constructive miles. They showed a maximum of 7/32 in. tread wear, which gives only 4,570 miles per unit of maximum wear.

Comparing the two sets of vanadium and the two sets of carbon steel tires on the basis of mileage per average tread wear there is an increase of 108 per cent in favor of the former. The mileage per 1/16 in. average wear for each of the four engines was as follows:

Vanadium Tires.		Carbon Tires.	
Eng. No.	Mileage per 1/16 in. Avg. wear	Eng. No.	Mileage per 1/16 in. Avg. wear
196	11,494	235	5,333
124	11,042	228	5,483
Average	11,268	Average	5,408

It will be noted that the mileage per unite of wear is very uniform in the case of both types of tires.

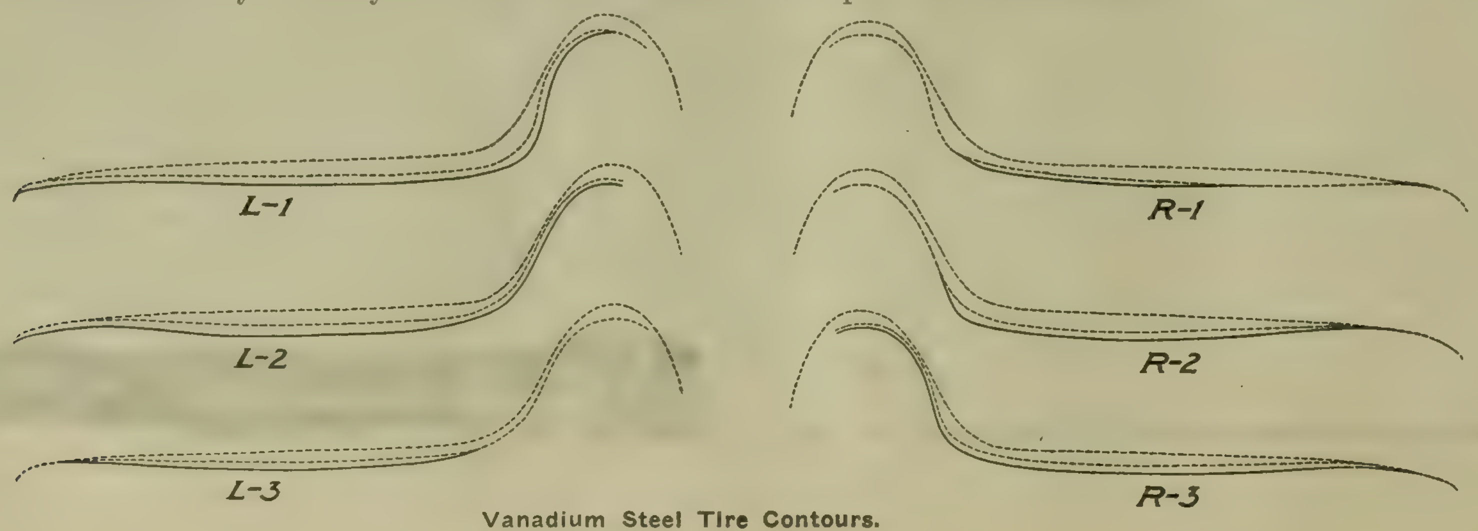
All of the above locomotives are of the 0-6-0 type, having a total weight on drivers of 140,000 lbs., giving an average of 23,300 lbs. per wheel on the rail. The tires are 44-in. I. D. and 4 in. thick and the rigid wheel base is 11 ft.

The Western Maryland applied two sets of heat-treated chrome-vanadium steel passenger engine tires for test purposes to Pacific type locomotives, Nos. 156 and 158, respectively. Those on the first mentioned locomotive were applied in April of last year, the other set some time later.

Contours of the first set were taken this month, after 11 months' service. No contours of the other have yet been taken, but the railroad company reports that the engine has just gone through the shop for general repairs and the tires were not turned.

Comparison between the performance to date of vanadium steel tires on locomotive No. 156 and the average for three sets of plain carbon steel tires on sister engines running in the same district show an increase of 148 per cent in mileage per 1/16 in. maximum tread wear in favor of the vanadium steel tires.

Up to March 1 the vanadium steel tires had made 49,096 miles. The maximum tread wear was 3/16 in., or 16,365 miles per 1/16 in. maximum wear. The three engines equipped with carbon steel tires showed respectively 5,393, 6,140 and 7,250 miles per 1/16 in. maximum tread wear, or an average of 6,594 miles per unit maximum wear.



Vanadium Steel Tire Contours.

The service of the vanadium steel tires is clearly shown by the accompanying illustration. This shows the present contours and contours taken in October, after six months' service, superimposed on each other and also on the original contour to which the tires were rolled. The full line represents the present contour and the middle dotted line the contour taken in October of last year. As will be seen, the flanges are in excellent condition, not being in any sense sharp. The flange wear is somewhat greater on the right than on the left tires. The tread wear, though quite uniform, shows, if anything, a little less wear in proportion during the last five months of service than during the first six months.

The Pacific type engine, to which these tires are applied, has a total weight in working order of 188,800 lbs., with 122,600 lbs. on drivers, or an average of 20,430 lbs. per wheel on the rail. The rigid wheel base is 11 ft. 10 in. and the total engine wheel base 30 ft. 4½ in. The tires are 62 in. I. D. and 3 in. thick.

The Grand Rapids & Indiana has in service some of the first heat-treated chrome-vanadium steel tires made. A set of this type of tires was applied in November, 1909, to locomotive No. 6, a ten-wheel type in passenger service. This set is still in service after four years and four months.

Up to February 1 these tires had made 281,646 miles. The railroad company reported that they expect them to make over 300,000 miles before they will be worn to the limit and have to be removed. Already they have made 100,000 miles more than the average total mileage for plain carbon tires of the same thickness on the same class of engine.

Up to the time the engine was last shopped, in March, 1913, they had made 226,124 miles, which was equivalent to 11,900 miles per 1/16 in. loss in thickness due to wear plus turning. This would seem to be an exceptional performance. In September, 1913, when contours were last taken, they had made 40,000 miles since being turned and showed a maximum of only 3/32 in. tread wear, or 26,660 miles per 1/16 in. wear.

From this rate of wear it would seem that the railroad officials' expectations as to the total mileage which they would make before being scrapped would be more than fulfilled, as they are still from ½ to 7/16 in. above the limit of wear allowed.

The engine to which they are applied has a total weight in working order of 169,800 lbs., of which 126,550 lbs. is carried on the driving wheels, giving an average of 21,000 lbs. per wheel on the rail. The rigid wheel base is 14 ft. and the total engine wheel base 25 ft. 9 in. The tires are 62 in. I. D. and were originally 3⅛ in. thick.

CAR COUPLER TESTS, UNIVERSITY OF ILLINOIS.

A series of tests is being conducted by the University of Illinois for the Scullin-Gallagher Iron & Steel Company of St. Louis, on a new style of car coupler, which is believed to be an improvement over the coupler now in use.

The weak point of most car couplers now in use is the face, this being the place where fracture generally occurs. The new style of coupler eliminates this difficulty by having a solid face and a new type of tail knuckle. A former test made by the university showed that when failure of the new style coupler occurred it was generally at the knuckle. After the first tests the design was changed so as to add about 15 lbs. of metal to the knuckle. The new design is now being tested under the supervision of Prof. J. M. Snodgrass of the railway engineering department.

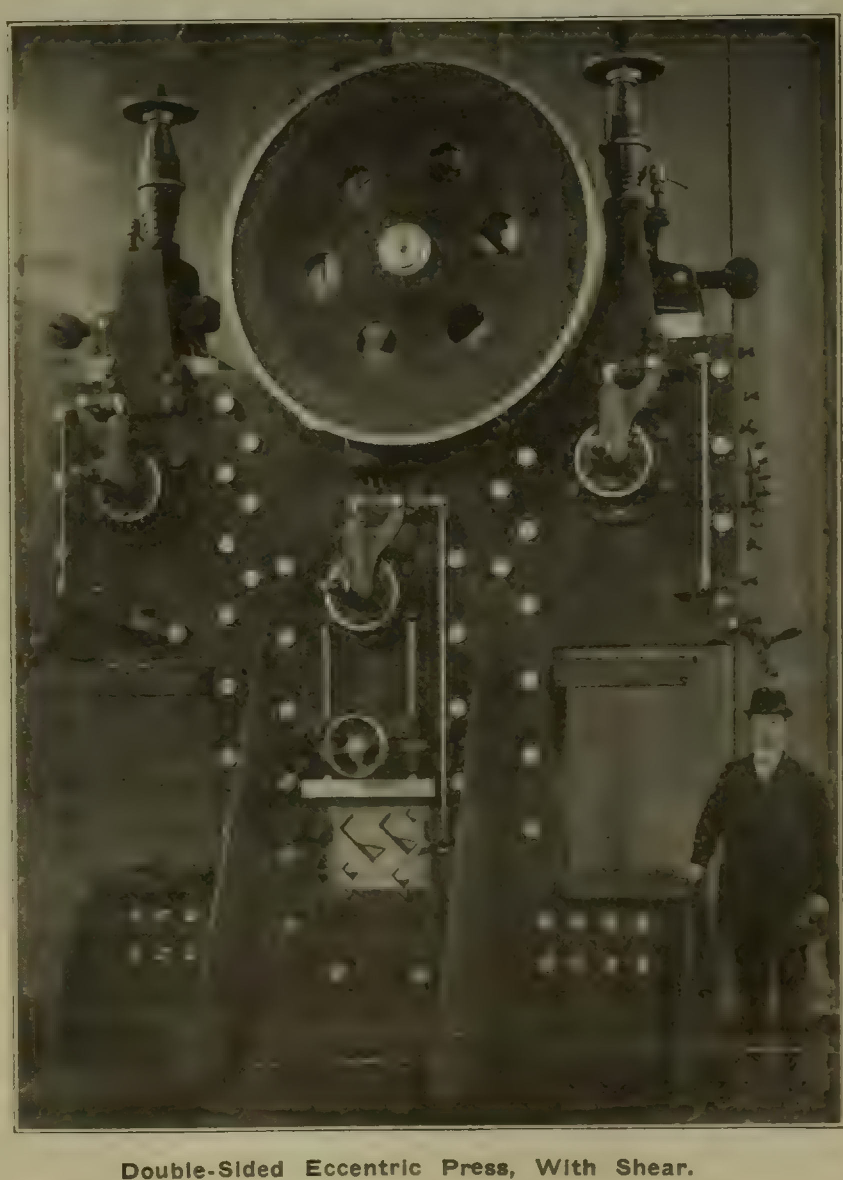
Four sets of tests are made: the ''striking test,'' the ''jerk test,'' the ''guard-arm test'' and the ''pulling test.'' In the striking test the coupler is placed in the drop testing machine and a 1,640-lb. weight let fall on it from varying heights.

The Lake Shore & Michigan Southern has decided, it is said, to electrify the Dunkirk, Allegheny Valley & Pittsburgh from Warren, Pa., to Youngville, 9 miles.

SPECIAL MACHINE FOR STEEL-CAR BUILDING.

The double-sided eccentric press with a profile shear built in between the two sides, here illustrated, was built by the Wilhelmsütte of Saalfeld, Germany. Each press side can exert a maximum pressure of 250 gross tons; the central profile shear 300 tons. It is principally intended for the under framing of steel and iron passenger and freight cars. I beams and channel irons are cut in the central portion to the requisite lengths; on one press there are flanging tools for punching both flanges at once, thus avoiding all turning of the work piece. The other press side is used for profile punching. The entire work of preparing a sill, which was formerly done on three separate machines and took 18 to 20 minutes, is done on this machine in about five. It comes in handy also for various other work; for instance die-forging—one press side doing the rough work and the other cutting off the fins. Further, it is employed in hot forging of axle holders; one press side cutting out the piece and the other finishing it. One special feature is the device for regulating the stroke between 1.18 inches and 3.94 inches by means of a screw. This shortening and lengthening of the stroke takes place only on the upper part, so that the ram always comes down to its lowest position, no matter what the stroke length; this doing away with vertical adjustment of the dies by shims. As the machine has a high throat the guides are plenty long, and are adjustable from all sides by strips. To obviate bending of the eccentric shaft, all the gear wheels lie close to the main frame and the couplings are placed outside. These latter are automatic, and after every stroke bring the slide to the highest position for which it is adjusted. They can, however, be thrown in and out for steady continuous work. A special hand-lever serves to adjust the dies. The power is applied to the slide by an eccentric shaft with double bearings and pitmans. The latter have phosphor-bronze bushings in their eccentric bearings, and press against hardened steel plates in the slide.

The profile knife can be adjusted to cut I beams and channel



Double-Sided Eccentric Press, With Shear.

iron 10° obliquely, and angle-iron either at right angles or at any desired oblique angle. The hold-down operates with screw and hand-wheel.

The machine is driven by an electric motor of 24 h. p. through a triple reducing gear, the gear-wheels being malleable Siemens-Martin steel castings with hobbed teeth. The eccentric presses make twenty 3.94-inch strokes a minute; the profile shear makes fifteen cuts a minute. Should any one of the three parts of the machine be out of service for slide adjusting, etc., the other two can be run.

The main frame consists of two boilerplate sheets having a tensile strength of 92,450 lbs. per square inch; stiffened by four wide gussets as feet. They are assembled with the interior parts of the machine and with the slide-guides by shearing bolts, these being deemed preferable to rivets, and give a more durable stiffness.

When used for drawing, the machine is used with a table which is adjustable in height.

WATER COOLING DEVICE FOR TRAILING TRUCKS.

By A. B. Lawson.

Because of trouble experienced on fast freight and through passenger locomotives on account of hot bearings on the tenders and locomotive trailing trucks a water cooling device has been adopted on one road and has overcome the trouble to a very great extent.

The valve for this device is extended up through the bottom of the tank at the edge into the water, it being applied on a line with the truck center. Four valves are required for the tender.

The sides of the tank projects over the tender frame floor, which makes it easy to apply these valves and where there is not sufficient room they are applied on an angle.

The valves are entirely of brass, to prevent corrosion, and are controlled from the ground. A hose leads from the valve to a brass connection into the journal box. Only one hose is carried for each valve, but each journal box is arranged with a connection, and as hot journals develop the hose is connected

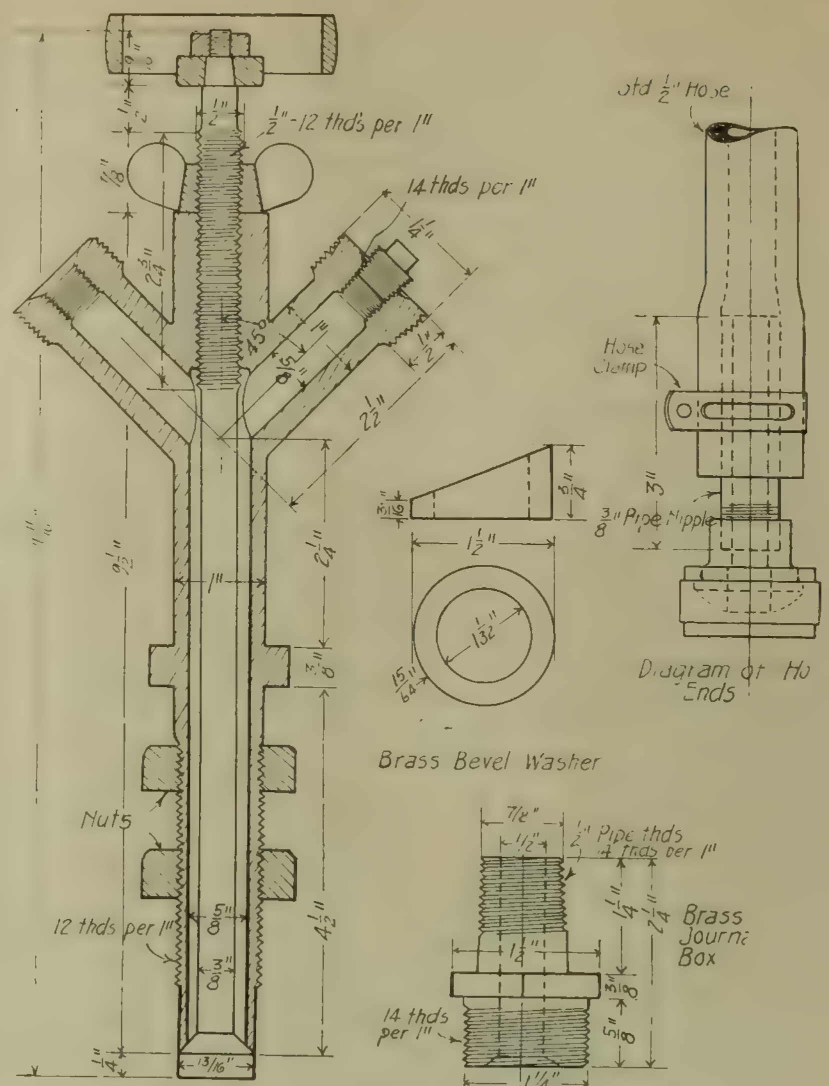


Fig. 2—Diagram of Hose Ends.

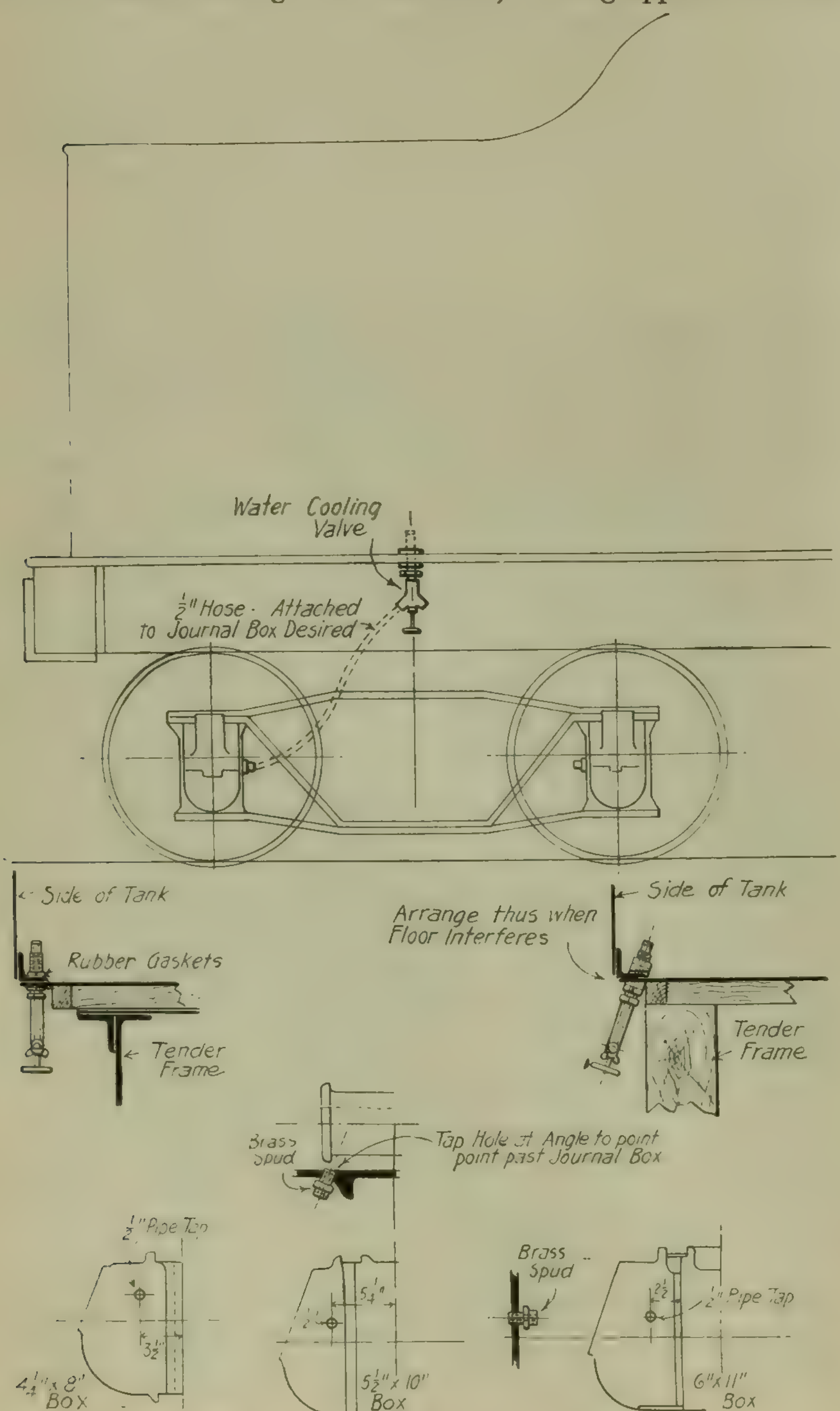


Fig. 1—Arrangement and Details.

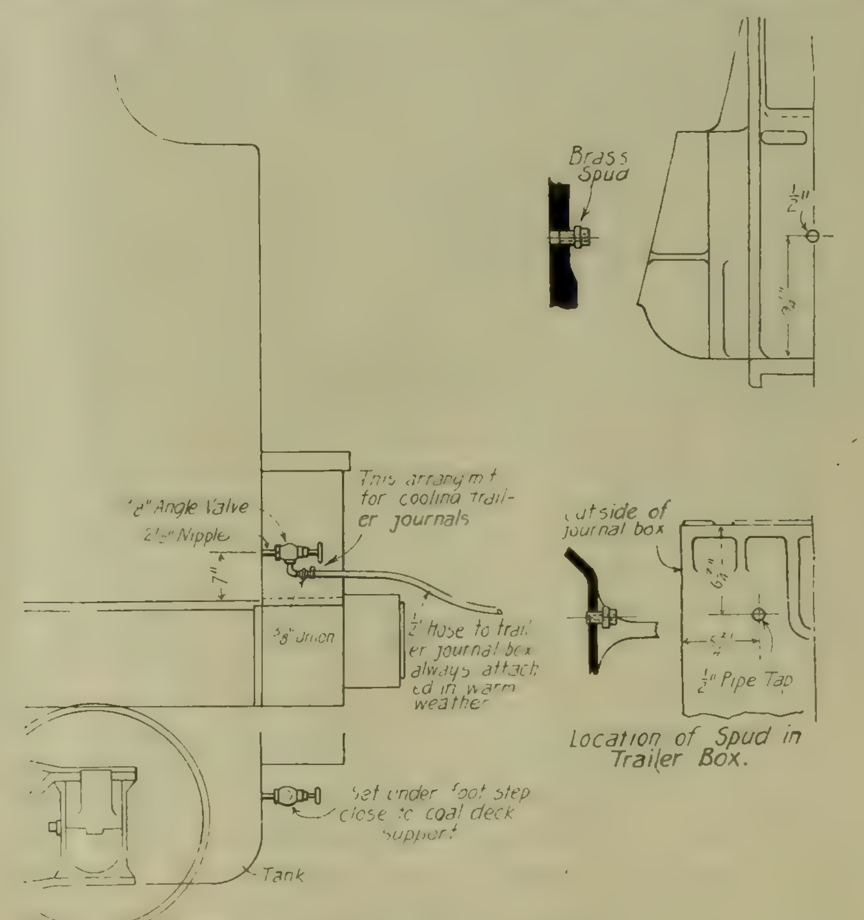


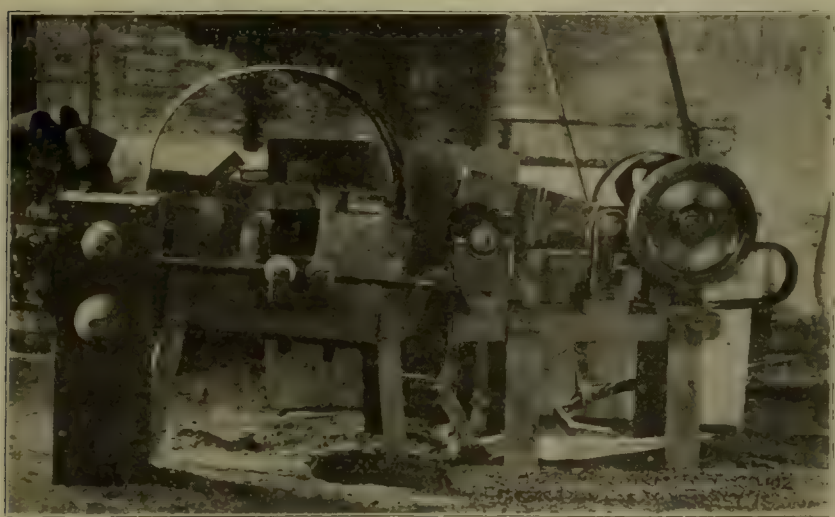
Fig. 3—Cooling Device for Trucks.

to the hot journal, and the opposite side of valve is closed with a standard ⅜-inch pipe plug. Figure 1 shows the application of valve to tank and the drilling of the various size boxes.

Figure 2 shows details of valve, journal box spud, bevel washer and hose ends. The length of hose required for the tender is four feet.

For the trailing truck ⅜" angle valves are connected into the tank by a ⅜" pipe nipple, and the hose is connected to these angle valves by means of standard service ells and pipe unions. The length of hose required is twelve feet and one is carried on each side.

Figure 3 shows application and drilling of trailing truck journal box.

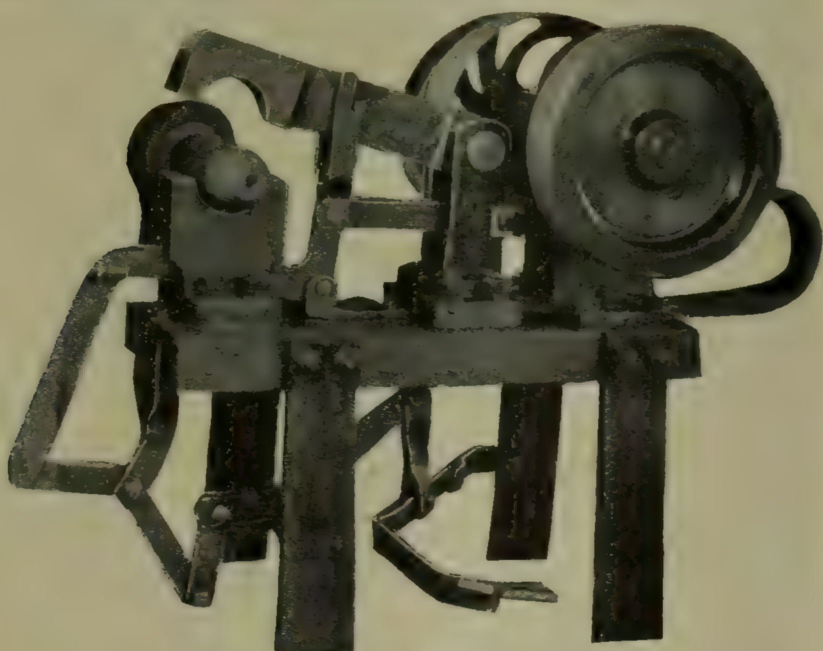


Oil Furnace and Flue-Welding Machine.

SUPERHEATER FLUE WELDING MACHINE.

By W. P. Hobson, M. M., Chesapeake & Ohio Ry.

The illustrations show a machine for welding 4½-inch and 5½-inch superheated flues, which was designed by Jas. W. Mulcahy, foreman blacksmith shop of the Chesapeake & Ohio shops at Covington, Ky., and which was built at the shops. One of the illustrations show the machine alone, while another shows it in conjunction with the oil furnace. The machine produces a weld that is the most perfect in every respect that I have had the opportunity of seeing. The welding arm or hammer is actuated by a belt-driven shaft. By pressing on the foot lever the motion is transmitted through a system of levers until the upright arm which holds the striking hammer is drawn back, thus allowing the hammer to get into action.



Flue-Welding Machine, C. & O. Ry.

The machine was built out of old scrap car axles at a total cost of $122, and its capacity is 20 superheater flues per hour, or 180 flues in nine hours. It is operated by three men, whose rates are 24.5c, 22.4c and 15c per hour. The cost per flue for welding is a fraction over 3c.

STRESSES IN THE PLATES OF CAST IRON WHEELS.*

By Louis E. Endsley, Professor Railway Mechanical Engineering, Purdue University.

The tests herein described were conducted upon the Master Car Builder's testing machine, located at Purdue University, Lafayette, Ind.

The purpose of the tests was to determine the stresses set up in the plate of different designs and weights of cast iron wheels under the varying conditions of brake shoe pressure and application.

DESCRIPTION OF THE MACHINE.

The Master Car Builder's brake shoe testing machine is fully described in detail in the proceedings of the Master Car Builders' Association for 1894 and supplement in 1907. A brief description of the machine is here given. By the use of the machine, a standard brake shoe may be made to act upon the face of a revolving car wheel mounted upon the same axle with a heavy fly wheel, until the whole system is brought to rest. The car wheel to which the shoe is applied may be either steel, steel-tired or cast-iron, and in any case is 33 inches in diameter. A double-cylinder steam-engine serves to revolve the machine. The pressure with which the shoe is made to act upon the car wheel is regulated by weights applied to a system of levers, while the tangential pull resulting from the application is recorded upon a paper scroll by an Emery testing machine.

Fig. 1—Brake Shoe Testing Machine, Purdue University, Lafayette, Ind.

The machine is also equipped with a special apparatus whereby it may be run steadily at a given speed, the shoe being automatically applied and released.

In preparation for the test, precautions were taken to insure good contact between shoe and wheel. The process consisted in making repeated applications of the shoes to the wheel under comparatively light pressure until a 90 to 95 per cent of the full bearing surface of the shoe was obtained. This accomplished, the record tests were made.

An illustration of the machine is shown in Fig. 1. This shows clearly the wheel mounted upon the axle, the leverage for applying the normal load to the shoe and the tangential arm which runs back to the Emery recording machine. It also shows in the back ground the engine for driving the same. The thermometers placed in the wheel for recording temperature in the rim, plate and the hub of the wheels are also shown.

DESCRIPTION OF WHEELS.

The wheels tested were cast iron wheels and there were nine in all. They were given for the purpose of the test, laboratory numbers from one to nine, inclusive.

*A paper delivered before the Western Railway Club.

SECTION of 625# MCB WHEEL

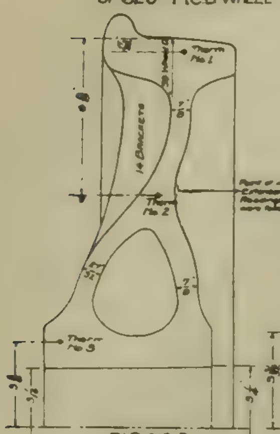


FIG No 3

SECTION of 675# MCB WHEEL

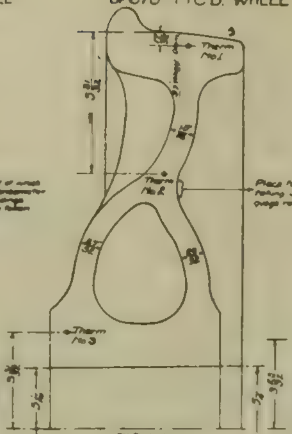


FIG No 4

SECTION of 725# MCB WHEEL

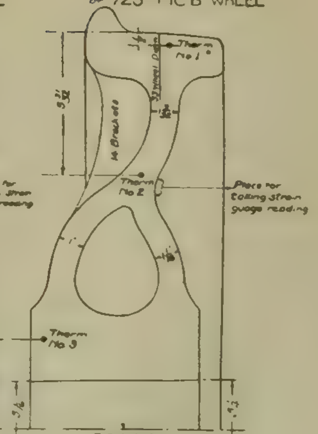


FIG No 5

SECTION of 740# A P WHEEL

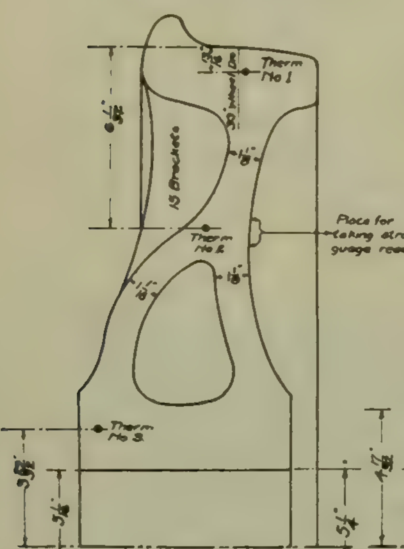


FIG No 8

SECTION of 840# A P WHEEL

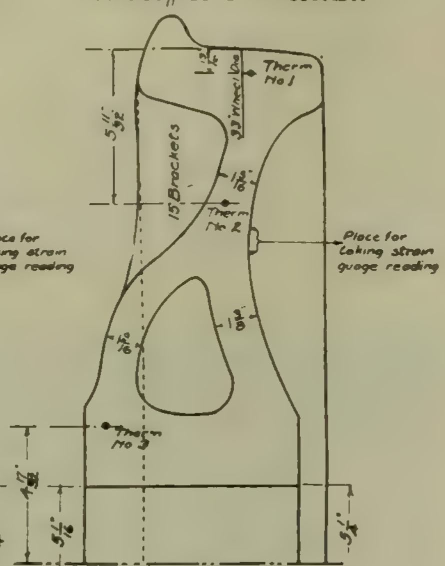


FIG No 9

Wheel No. 1 was a standard 625-pound MCB wheel. A cross section of half the wheel is shown in Fig. 3.

Wheel No. 2 was a standard 675-pound MCB wheel. A sketch of half the wheel is shown in Fig. 4.

Wheel No. 3 was a standard 725-pound MCB wheel. A sketch of half the wheel is shown in Fig. 5.

Wheel No. 4 was a 640-pound wheel having on "arch plate" and will hereafter in this report be referred to as an AP wheel. A sketch of one-half the wheel is shown in Fig. 6.

Wheel No. 5 was a 690-pound wheel also of the arch plate design. A sketch of half the wheel is shown in Fig. 7.

Wheel No. 6 was a 740-pound AP wheel. A sketch of half the wheel is shown in Fig. 8.

Wheel No. 7 was an 840-pound AP wheel, a sketch of which is shown in Fig. 9.

Wheel No. 8 was a 690-pound wheel having a specially designed plate. This wheel had the same dimensions as the MCB 625-pound wheel, except that metal had been added to the plate of the wheel as shown in Fig. 10 to make it weigh 690 pounds.

Wheel No. 9 was a 690-pound wheel having a specially designed rim. This wheel had the same dimensions as the 625-pound MCB wheel, with the exception that metal was added to its rim shown in Fig. 11 bringing the weight up to 690 pounds.

DESCRIPTION OF SHOES.

There were five shoes used in the tests. These were given for the purpose of this work, laboratory numbers, 400, 406, 407, 408 and 409.

Shoe No. 400 was a soft cast iron shoe and was only used in a special test to determine the effect on the stress in the plate of the wheel by placing the shoe in contact with the throat and then with the rim.

This was accomplished by grinding away about half of the face of the shoe on the side where the contact was not desired.

Shoe No. 406 was a Streeter shoe. It had two L-shaped steel inserts.

Shoe No. 407 was a cast iron shoe with chilled ends.

SECTION of 640# A P WHEEL

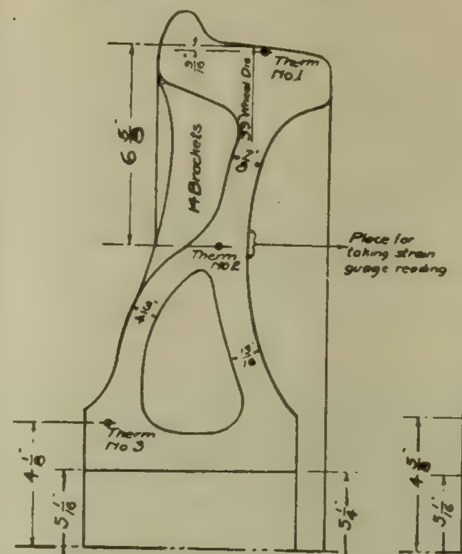


FIG No 6

SECTION of 690# A P WHEEL

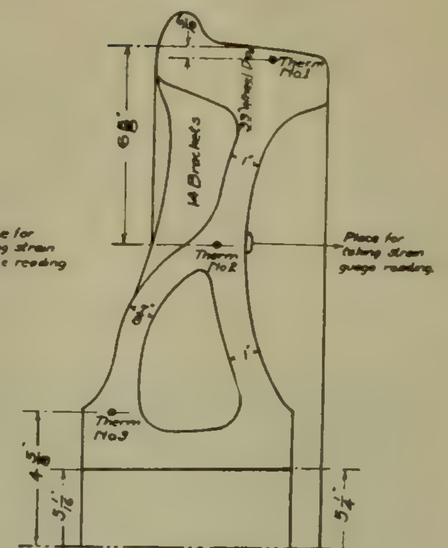


FIG No 7

SECTION of 625" MCB WHEEL WITH METAL ADDED TO PLATE TO BRING WEIGHT TO 690"

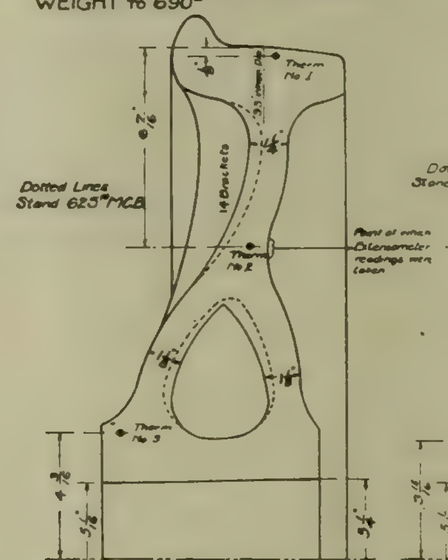


FIG No 10

SECTION of 625" MCB WHEEL WITH METAL ADDED TO RIM TO BRING WEIGHT TO 690"

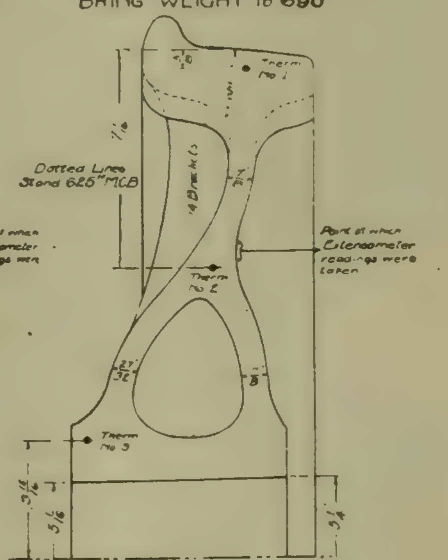


FIG No 11

Shoe No. 408 was a Diamond "S" shoe. This shoe had an expanded metal insert which was plainly visible.

Shoe No. 409 was a cast iron shoe with the ends chilled and it also had two "V" shaped inserts in it.

METHOD OF TESTING TO DETERMINE STRESS IN PLATE OF WHEEL.

For the purpose of determining the stress in the plate of the wheel a Berry strain gauge was employed. The gauge is so constructed that elongation in a two-inch gauge length can be determined to .0001 of an inch. The method of applying the strain gauge is shown in Fig. 2.

The point at which readings were taken for each of the wheels is shown in Figures 3 to 11. These figures also show the location of three thermometers which were used in each of the wheels to determine the temperature in the rim, hub and plate.

The temperature as determined by the thermometer in the plate was used to correct the elongation as read on the Berry strain gauge, i. e., there was an elongation due to the expansion of the metal from heat and also elongation caused by the strain set up through the difference in temperatures of the wheel rim and its rub. The procedure in testing for this elongation was as follows:

Only one test was made on any one wheel per day, so that before a test began the temperature of the entire wheel was the same. Before each test readings of all three thermometers were taken and were found to be always the same; thus, when the test began there was no stress in the wheel plate due to heat. At the beginning of a test a reading of the Berry strain gauge was also taken, after which the brake shoe machine was started and a speed of approximately 20 miles per hour was maintained. Readings of the temperatures and strain gauge were taken at stated intervals by stopping the machine, such stops occupying from 40 to 60 seconds.

During the test of wheel No. 5 or the 690-pound AP wheel all shoes were tested at the following pressures: 800-pound continu-

ous, 2,808, 4,152 and 6,840 pound intermittent. Under the 800 pounds pressure the shoe was left on the wheel the entire time. Under the other three pressures the shoe was in contact for 610 revolutions. The three heavier pressures were carried on until 100 applications of the brake shoe had been made. Readings were taken after the 2d, 4th, 6th, 8th, 10th, 15th, 25th, 30th, 40th, 50th, 60th, 70th, 90th and 100th applications.

In the case of the 800-pound pressure in which the shoe was in contact with the wheel the entire time, the tests were continued through the same length of time or until the same number of revolutions of the wheel had been made as during the test of the heavier pressures. Readings of the temperatures and strain gauges were taken at approximately the same interval, i. e., after 1,600, 3,200, 4,800, 6,400, 8,000, 12,000, 16,000, 20,000, 24,000, 30,000, 40,000, 48,000, 56,000, 64,000, 72,000 and 80,000 revolutions of the wheel. Wheel No. 5 was also tested under a continuous brake shoe pressure of 4,152 pounds. This test continued until the plate of the wheel cracked. The other chilled iron wheels, namely, Nos. 1, 2, 3, 4, 5, 6, 7, 8 and 9, were each tested under brake shoe pressure of 800, 2,000 and 3,000 pounds continuous application. During the testing of the above mentioned wheels the machine was stopped every five miutes and a reading of the temperatures and the strain gauge were taken.

The tests under the above pressures were continued until the stress indicated by the elongation was approximately constant. This, however, did not require the same time for the different pressures as is indicated by the results given in the tables which will be explained a little later.

Wheel No. 2 was tested under a brake shoe pressure of 4,152 pounds which was continued until the plate of the wheel cracked.

METHOD OF CALCULATING THE STRESS FROM THE READING OF THE BERRY STRAIN GAUGE.

In order to determine the relation of stress to strain, i. e., the relations between elongation and stress, three test bars were cast of wheel iron. These bars were approximately 18 inches long and for a distance of 11 inches in the center the diameter was 1.8 inches and the ends were approximately 2¼ inches in diameter. These bars were tested in tension at the testing laboratory of Purdue University.

Fig. 2—Method of Applying the Berry Strain Gage.

From the average results of two of these bars which showed about the same results, the third one having a flaw in it, a curve was plotted. In this curve the elongation in .0001 inch per inch was plotted against the stress in thousand pounds per square inch. The upper end of the curve was obtained by continuing the curve in accordance with the equation of the test bar curve.

From the readings taken of the strain gauge throughout the test the elongation in inches per inch could be determined. As it was known that some of the elongation was due to heat expansion a correction was made from the total elongation by obtaining the rise in temperature from the thermometer No. 2, the rise being figured in each case from the original reading before the test began. By using the co-efficient of expansion of cast iron which is .00000556 and multiplying this by the rise in temperature of No. 2 thermometer the elongation in inches per inch due to heat was determined. This heat elongation was subtracted from the total elongation and the elongation due to stress was obtained. By the use of this elongation and the curve, the stress in pounds per square inch was obtained. The relation of stress to strain in cast iron is a curve. This is typical of cast iron. It is well known that there is always some set produced in a test bar of cast iron after it has been tested. That is, the bar does not return to its original length after the load is released. This, however, was not shown to be true after the plates of the wheel had been subjected to a strain due to the heat produced by the brake shoe, as it was shown that the reading of the strain gauge was the same after the wheel had cooled as it was before the test began. This was true of all wheels tested, so there must be some difference in the effect of straining a plate in regard to its set. For this reason it was felt that this curve would not only show the relation of stress to elongation for the first test on any wheel, but could be used for repeated tests on the same wheel. This also was proved by repeating tests under the same condition, in that the same elongation was obtained. The exact procedure of obtaining the stress for any elongation will be explained later.

RESULTS.

We find that in most cases the stress in the plate for any given wheel is nearly proportional to the difference in temperature between the hub and the rim. This holds true whether being the temperature be high or low, the difference in temperature being the controlling factor. It will also be seen that for any given test this difference in temperature becomes a constant the stress

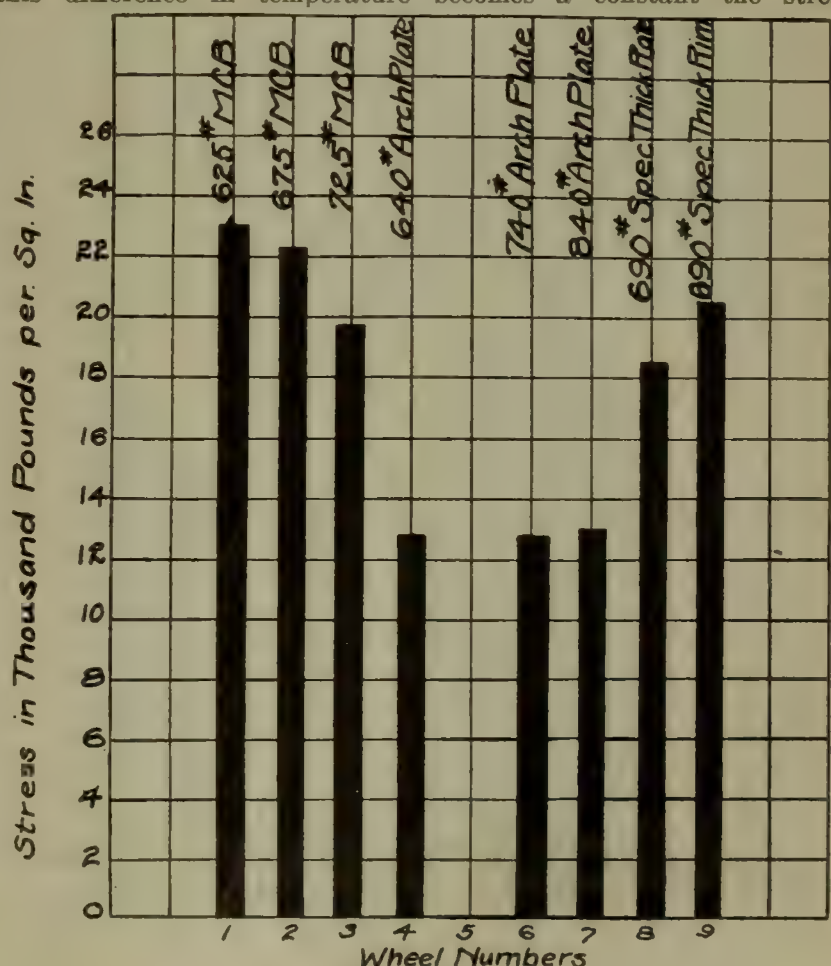


Fig. 12.

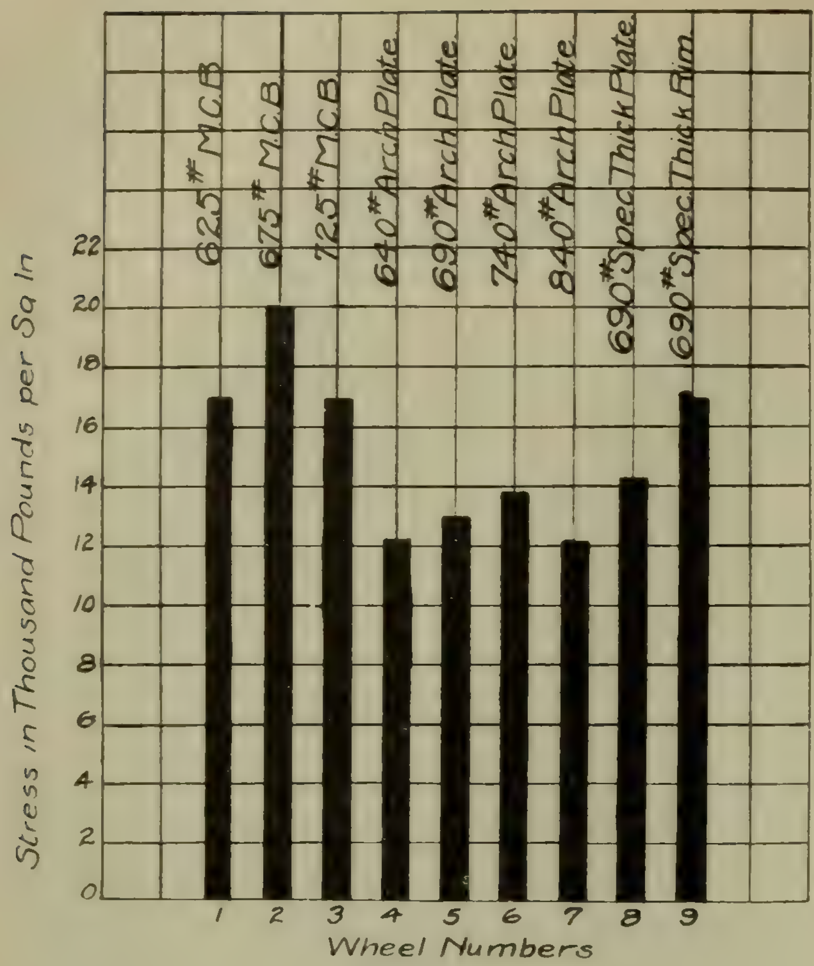


Fig. 13.

also remains constant. In about 30 applications, neglecting individual error of reading, the stress remained constant throughout the remaining applications. The rise in temperature of the three thermometers was uniform until a certain number of applications had been made after which the temperature would remain practically constant; that is, after this point had been reached the radiation of heat was equivalent to the added heat.

By comparing the results for any wheel while using 800 pounds continuous pressure with that of the same wheel under 6,840 pounds intermittent pressure practically the same amount of work being done in both cases, the resultant maximum stress is for all practical purposes the same. That is, for any given wheel the stress set up in the plate of the wheel is almost proportional to the amount of work done by the brake shoe in a given time. The thing which affects this stress in the plate most is the design of the wheel. This is well shown by comparisons given in Figs. 12 to 14. Fig. 12 gives the comparison of the stress developed in the plate of the nine wheels under a continuous brake shoe pressure of 800 pound after the test on each wheel had continued for 32,000 revolutions or at a point when the stress in each wheel had practically become constant. It will be seen from this figure that the stress varies from about 12,000 pounds in the 840 pound arch wheel to 20,000 pounds in the 675 pound MCB wheel.

It will also be seen that the three arch plate wheels Nos. 4, 5 and 6 weighing respectively 640, 690 and 740 pounds, had a much lower stress than wheels Nos. 1, 2 and 3 of the 625, 675 and 725 standard MB wheels. That is, the average stress obtained indicated in this figure on the three MCB wheels was 17,900 pounds and on the arch plate wheels, namely, 4, 5 and 6 designed for the same service, the average stress was 13,000 pounds or the reduction in stress was 4,900 pounds.

Wheels Nos. 8 and 9, which were made by increasing the weight of the 625-pound wheel to 690 pounds, show some interesting results. Wheel No. 8, which had 65 pounds added to the plate, showed considerably less stress than the standard 625-pound wheels, but wheel No. 9 which had the 65 pounds of metal added to the rim of the wheel, did not show any less stress with a continuous brake shoe pressure of 800 pounds. That is, this metal added to the rim was practically of no value in reducing the stress in the plate of the wheel due to brake shoe friction.

The comparison in stress of the different wheels as shown in Fig. 13 under a constant brake shoe pressure of 2,000 pounds after the wheel had made 3,200 revolutions indicates practically the same conclusions as those shown in Fig. 12. Here it will be seen the difference in stress between the low and high stress steel is greater than in the 800-pound tests, due to the rapid rise in temperature of the rim. Also the results shown in Fig. 14 giving a comparison of the several wheels under a continuous brake shoe pressure of 3,000 pounds after the wheel had revolved 3,150 revolutions indicate the same relative difference, but then again the difference between the low and high steel wheel.

By looking at the results shown in Figs. 12 and 14 it would seem that the MCB 675-pound wheel, which gave the highest average stress, must be the poorest designed wheel tested.

In order to show the exact difference of applying the shoe to the throat of the wheel and then to the rim of the wheel, curves were plotted and they indicated that while the final stress is practically the same under both conditions, the stress set up in the plate during the early part of the application is much greater when the shoe is applied to the rim than when it is applied to the throat.

From a careful study of these results it would seem that the plate of the MCB design of cast iron wheel might be improved by making the inside of the plate a smooth curve with a comparatively large radius instead of reversing the curvature of the plate and making a sharp curve as now made.

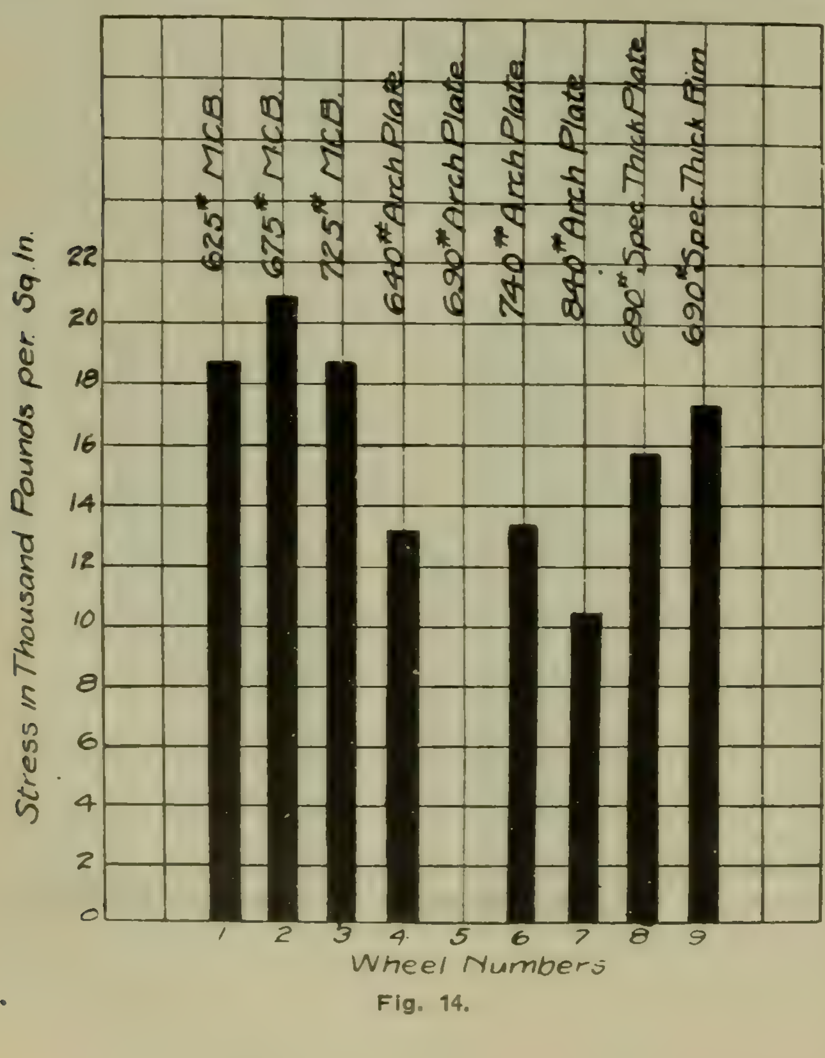


Fig. 14.

TO TEST the general observance of rules on the Pennsylvania Railroad, 5,961,732 observations were made and reported in 1913, with 8,120 failures, showing a record of 99.9 per cent perfect. These tests included a great variety of violations, from employes reporting late to smoking on duty, using locomotive whistle unnecessarily, leaving headlight burning in daytime, using foot to adjust couplers, going between cars to repair leak in air brake hose without notifying train crew, placing torpedoes where persons are liable to be injured by them, and the use of reliable watches. In all 93 different kinds of observations were made. Exactly 784,675 observations were made as to the use of intoxicants by employes, and only 158 cases required discipline.

MECHANICAL CONVENTIONS FOR 1914.

Railway associations in all departments are doing a great deal of good and should be encouraged whenever possible. Following is a list of the associations in the mechanical department, the dates and places of the next convention of each and the name of the secretary. There is also given a list of the topics to be covered at each meeting, so that the field and work of the respective associations may be compared.

Air Brake Association.

The twenty-first annual convention of the Air Brake Association will be held at the Hotel Pontchartrain, Detroit, Mich., on May 5, 6, 7 and 8. F. M. Nellis, 53 State St., Boston, Mass., is secretary of the association. The subjects to be presented are as follows:

1. "Electro-Pneumatic Signal System for Passenger Trains," by L. N. Armstrong.
2. "Air Hose," by T. W. Dow.
3. "Clasp Type of Foundation Brake Gear for Heavy Passenger Cars," by T. L. Burton.
4. "Air Gage and Conductor's Valve in Caboose Cars," by Mark Purcell.
5. "The Analysis of the Factors Involved in Controlling and Stopping Passenger Trains," by Walter V. Turner.
6. "One Hundred Per Cent Efficiency of Freight Train Brakes," by Fred Von Bergen.
7. "Recommended Practice," S. G. Down, G. R. Parker, H. A. Wahlert, J. R. Alexander and N. A. Campbell.
8. Topical Subject—"Mountain Grade Work," by H. H. Forney.
9. Topical Subject—"Modern Train Building," by G. W. Nolan.

Railway Storekeepers' Association.

The eleventh annual convention of the Railway Storekeepers' Association will be held at the Hotel Raleigh, Washington, D. C., on May 18, 19 and 20, 1914. The standing committees of the association expect to have their reports ready within a short time and these will also be printed and distributed before the meeting. Papers on the regular subjects will also be distributed to all members. J. P. Murphy, Box C, Collinwood, O., is secretary of the association. The regular subjects are as follows:

K-1. "Stores Department Expenses."

K-2. "How to Obtain the Greatest Efficiency from Employes in the Stores Department."

K-3. "Handling of Stationery."

K-4. "Classification of Electric Railway Materials."

The committee reports are as follows:

Recommended Practices—Chairman, H. S. Burr.

Accounting—Chairman, E. E. McCracken.

Piece Work—Chairman, W. W. Eldridge.

Standardization of Tinware—Chairman, W. F. Jones.

Stationery—Chairman, S. C. Pettit.

Uniform Grading and Inspection of Lumber—Chairman, J. H. Waterman.

Scrap Classification—Chairman, W. T. Bissell.

Membership—Chairman, W. M. Portlock.

Standard Buildings and Structure—Chairman, J. H. McMillen.

Book of Standard Rules—Chairman, J. G. Stuart.

Marking of Couplers and Parts—Chairman, A. H. Young.

Railway Fuel Association.

The International Railway Fuel Association will hold its sixth annual convention at the Hotel LaSalle, Chicago, Ill., May 18, 19, 20 and 21. C. G. Hall, 922 McCormick Bldg., Chicago, is secretary-treasurer. The subjects for consideration at the meeting are:

Storage of Coal—Its Feasibility and Advantages to Producer, Carrier and Consumer.

Sizing of Coal for Locomotive Use.

A Uniform Method of Computing Locomotive Fuel Consumption for Office Statistics and Trip Performance.

Honeycombing and Clinker Formation.

Coal Space and Adjuncts of Locomotive Tenders.

Relation of Front End Design and Air Openings of Grates and Ash Pans to Fuel Consumption and Sparks.

Economies in Roundhouse and Terminal Fuel Consumption.

Pre-heating of Feed Water for Locomotive Boilers.

Master Boiler Makers' Association.

The eighth annual convention of the Master Boiler Makers' Association will be held at the Hotel Waldron, Philadelphia, Pa., on May 25, 26, 27 and 28. Harry D. Vought, 95 Liberty St., New York, is secretary of the organization.

Committee reports on the following subjects will be given at the meetings:

"Advantage or Disadvantage of Oxy-acetylene and Electric Processes for Boiler Maintenance and Repairs." F. A. Griffin, chairman.

"What Benefit Has Been Derived from Treating Feed Water for Locomotive Boilers Chemically?" T. F. Powers, chairman.

"What Can the Association Do to Get a Uniform Rule Regarding the Load Allowed on Staybolts and Boiler Braces?" C. P. Patrick, chairman.

"Advantages or Disadvantages of Flexible Staybolts to Be Used in Crown Sheets to Take the Place of Sling Stays." C. E. Steward, chairman.

"Advantage or Disadvantage of Combustion Chambers in Large Mallet or Pacific Type Engines, Other Than a Shorter Flue." A. N. Lucas, chairman.

"What Shape and Size Head of a Radial Staybolt in Crown Sheet of Oil-burning Engines Gives the Most Efficient Service?" C. L. Hempel, chairman.

"Does the Method of Flue Cleaning or Rattling Have Any Effect on the Further Scaling Up of Flues?" B. F. Sarver, chairman.

"Combustion and Fuel Economy." C. F. Petsinger, chairman.

"Proper Inspection of a Boiler While in Service." C. E. Fourness, chairman.

"Law." W. H. Laughridge, chairman.

The first day will be given over to addresses by a number of prominent men and the business of the association. The committee reports will be taken up on May 26, the second day. On May 27 members and visitors will visit the plants of the Parkesburg Iron & Steel Co. and the Lukens Iron & Steel Co. Two special addresses and the unfinished business will be the order on the last day, as well as the annual dinner at 7:00 p. m.

Master Mechanics and Master Car Builders' Association.

The forty-eighth annual convention of the Master Car Builders' Association will be held at Youngs Million Dollar Pier, Atlantic City, N. J., on June 10, 11 and 12. The forty-seventh annual convention of the American Railway Master Mechanics' Association will be held at the same place the following week, June 15, 16 and 17. J. W. Taylor, Karpen Building, Chicago, is secretary of both organizations.

The following subjects will be covered by standing and special committees at the Master Car Builders' meeting:

"Arbitration."

"Revision of Standards and Recommended Practice."

"Train Brake and Signal Equipment."

"Brake Shoe and Brake Beam Equipment."

"Coupler and Draft Equipment."

"Rules for Loading Materials."

"Car Wheels."

"Safety Appliances."

"Car Construction."

"Car Trucks."

"Prices for Labor and Material."

"Train Lighting and Equipment."

"Tank Cars."

"Damage to Freight Equipment by Unloading Machines."

"Specifications and Tests for Materials."

"Retirement of 40,000 and 50,000 Pounds Capacity Cars from Interchange."

The following subjects will be covered by standing and special committees of the American Railway Master Mechanics' Association:

"Revision of Standards and Recommended Practice."

"Mechanical Stokers."

"Safety Appliances."

"Design, Construction and Inspection of Locomotive Boilers."

"Locomotive Headlights."

"Standardization of Tinware."

"Use of Special Alloy and Heat Treated Steel in Locomotive Construction."

"Smoke Prevention."

"Revision of Standard Efficiency Tests of Locomotives."

"Revision of Air Brake and Train Signal Instructions."

"Superheated Locomotives."

"Train Resistance and Tonnage Rating."

"Statistics."

"Fuel Economy."

Also the following individual papers:

"Dimensions for Flange and Screw Couplings for Injectors." By O. M. Foster.

"Motors for Railway Shops." By B. F. Kuhn.

"Review of Work Done by Other Mechanical Organizations." By Dr. Angus Sinclair.

International Railway General Foremen's Association.

The tenth annual convention of the General Foremen's Association is to be held at the Hotel Sherman, Chicago, Ill., on July 14, 15, 16 and 17. The secretary is William Hall, 829 Broadway, Winona, Minn. Committees will report on the following subjects:

"Engine House Efficiency." Walter Smith, chairman.

"Cylinders, Pistons, Crossheads, Guides and Valves." J. T. Mullin, chairman.

"Practice and Methods of Maintenance and Repairs to the Air Brake and Its Appurtenances." C. M. Newman, chairman.

"Autogeneous Welding." C. L. Dickert, chairman.

The following papers will also be presented:

"The Taylor System." By W. W. Scott.

"Railroading at a High Altitude." By J. W. Scott.

Tool Foremen's Association.

The sixth annual convention of the American Railway Tool Foremen's Association will be held at the Hotel Sherman, Chicago, on July 20, 21 and 22. A. R. Davis, 750 Pine St., Macon Ga., is secretary and treasurer. The subjects to be covered are:

"Standardization of Reamers for Locomotive Repair Shops."

"Machine Tool Repairs, Methods of Handling, Records, Etc."

"Tool Room Grinding, Clearance, Angles, Grinding Wheels and Special Applications."

"Special Tools for Drilling, Reaming and Milling."

"Distribution of Tools for Shop Use, Arrangement of Tool Racks, Delivery of Tools, Etc."

"Dies for Cold Work, Press and Special Punching,"

Traveling Engineers' Association.

The twenty-second annual convention of this association will probably be held at the Hotel Sherman, Chicago, late in August. W. O. Thompson, Buffalo, N. Y., is secretary. Committees will report on the following subjects:

"Difficulties Accompanying Prevention of Dense Black Smoke and Its Relation to Cost of Fuel and Locomotive Repairs."

"Operation of All Locomotives With a View of Obtaining Maximum Efficiency at Lowest Cost."

"Advantage to Be Derived from Use of Mechanical Stokers Considering: (1) Increased Efficiency of the Locomotive; (2) To Increase the Possibility of Securing a Higher Type of Candidates for Position of Firemen; (3) The Utilization of Cheaper Grades of Fuel."

"Care of Locomotive Brake Equipment on Line of Road and at Terminals; Also Method of Locating and Reporting Defects."

Also the following papers:

"Advantages Derived from the Use of Speed Recorders and Influence of Same on Operating Expense." By Frederick Kirby.

"Practical Chemistry of Combustion." By A. C. Kenyon.

"Scientific Train Loading; Tonnage Rating." By O. S. Berger, Jr.

Master Blacksmiths' Association.

The twenty-second annual convention of the International Railroad Master Blacksmiths' Association will be held at Milwaukee, Wis., on August 18, 19, 20, 21 and 22. A. L. Woodworth, Lima, O., is secretary and treasurer. Committees will cover the following subjects:

"Flue Welding."

"Making and Repairing Frogs and Crossings."

"Carbon or High Speed Steel."

"Tools and Foremen."

"Electric Welding."

"Drop Forgings."

"Spring Making and Repairing."

"Piece Work and Other Methods of Having Work Done."

"Locomotive Frame Making and Repairing."

"Oxy-acetylene Process for Cutting and Welding of Metals."

"Case Hardening."

"Heat Treatment of Metals."

"Shop Kinks."

C. I. C. I. & C. F. Association.

The fifteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association will be held at Cincinnati, O., on August 25, 26 and 27. The discussions will cover the M. C. B. rules and other topics of interest to the car department. Stephen Skidmore, 6th and Millcreek, Cincinnati is secretary.

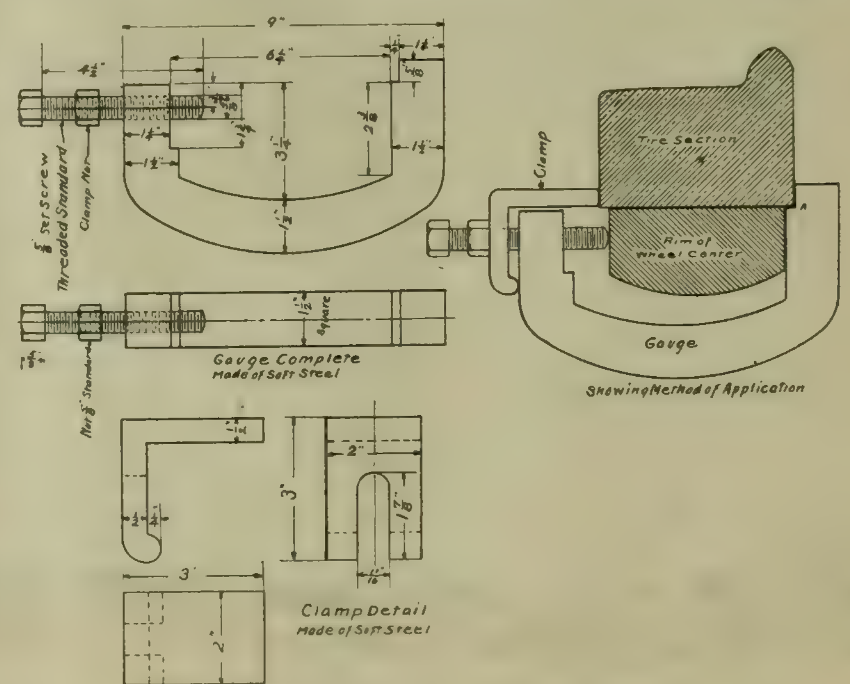
Painters' Association.

The Master Car and Locomotive Painters' Association will hold its annual convention at the Hermitage Hotel, Nashville, Tenn., on September 8, 9, 10 and 11. A. P. Dane, Reading, Mass., is secretary and treasurer.

GAUGE FOR DRIVING WHEEL TIRES.

By J. T. Hendrum, Florence & Cripple Creek R. R.

The sketch shows a distance gauge, the use of which eliminates all guess work in setting of tires. The gauge is placed on the rim of the wheel center between the spokes and has an offset at A, which fits against the tire section. Screwing down the set-screw against the rim serves to hold the gauge in position. After the tire is in place, the clamp is inserted and the clamp nut is screwed down until the tire is against the off-set



Distance Gauge for Applying Tires.

section of the gauge. Three gauges are used on each wheel and are kept in place until the tires have cooled sufficiently. The off-set at A, of course, is equal to the distance the tire projects inside the wheel center.

There is no measuring to be done when this distance gauge is applied and it insures the tire being on straight. The device is especially good when changing tires with the wheels under the engine, for you get away from trying to measure the tire distance on inside of wheel center, with the spring, spring hanger and frame in the way.

HYDROSTATIC TEST PUMP.

By L. E. Dix, M. M., Union Ry.

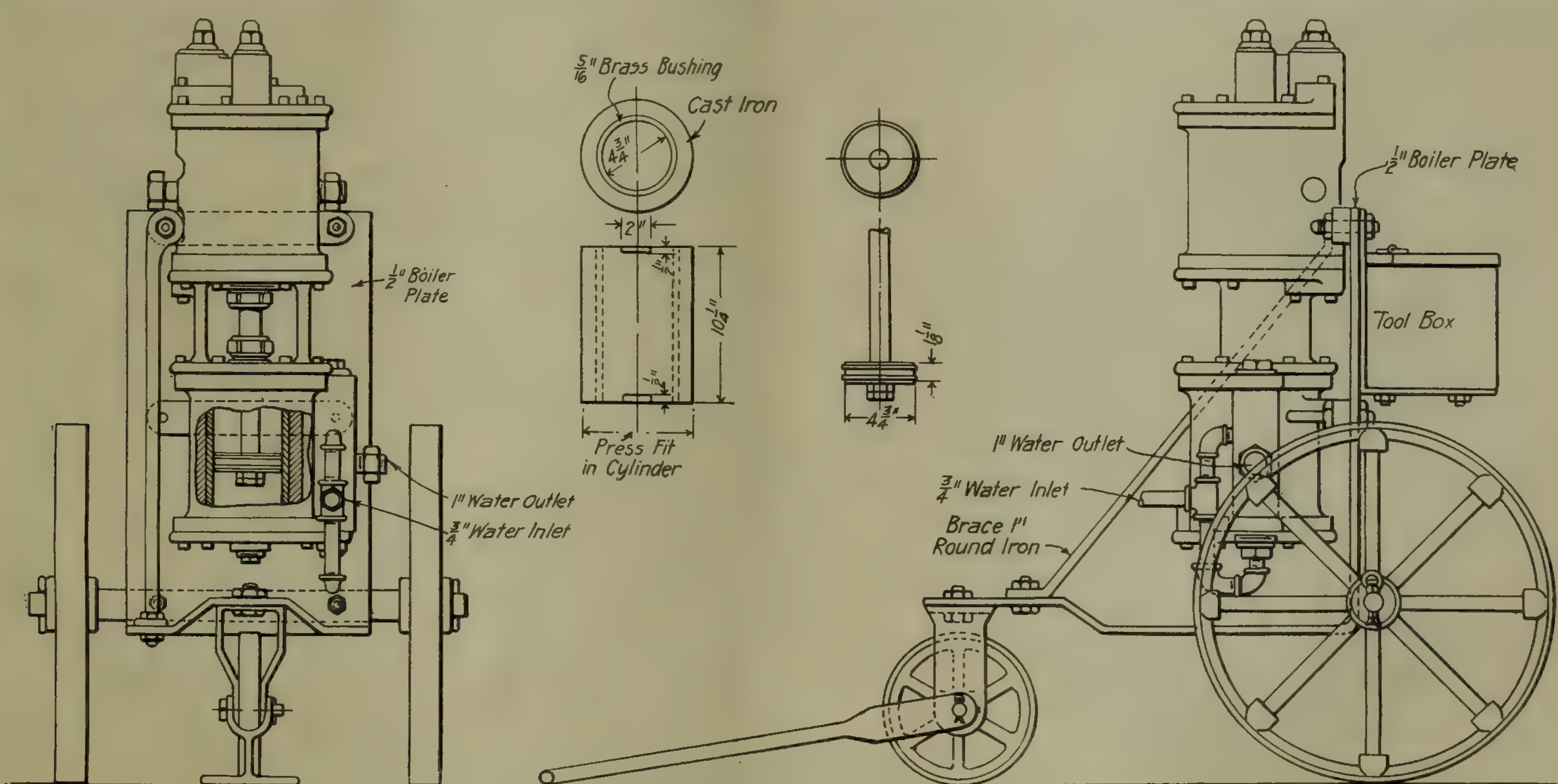
The test pump shown in the sketch was designed and built by H. J. Osborne, while master mechanic at the Valley Junction, Ia., shops of the Rock Island, and is being very successfully used at our shops. It is used for putting water pressure on boilers and consists of a scrap 8-inch air pump with the air cylinder bushed to 4¾ inches. The apparatus is mounted on a cart so that it may be taken to any part of the shop. The pump will run with steam, water or air and a pressure of 500 pounds may be obtained. The cost of the outfit will not exceed $50. One of these pumps is in use at McGehee, Ark., and another at Cedar Rapids.

A. KIPP, general car inspector of the New York, Ontario & Western at Middletown, N. Y., was present at the meeting of the executive committee of the Chief Interchange Car Inspectors and Car Foremen's Association, and his name should have been included in the report of the meeting published in our last issue.

LIST OF EXHIBITORS M. C. B. & M. M. CONVENTION.

Following is a list of concerns which have arranged for exhibit space at the convention of the Master Car Builders' and American Railway Master Mechanics' Associations at Atlantic City, June 10-17, 1914:

Acme Machine Tool Co., Cincinnati, O.
Acme Supply Co., Chicago, Ill.
American Abrasive Metals Co., New York City.
American Arch Co., New York City.
American Balance Valve Co., Jersey Shore, Pa.
American Brake Co., St. Louis, Mo.
American Brake Shoe & Foundry Co., Mahwah, N. J.
American Brass Co., Ansonia, Conn.
American Car & Foundry Co., New York City.
American Car & Ship Hdwe. Mfg. Co., New Castle, Pa.
American Flexible Bolt Co., Pittsburgh, Pa.
American Locomotive Co., New York City.
American Mason Safety Tread Co., Boston, Mass.
American Nut & Bolt Fastener Co., Pittsburgh, Pa.
American Roll Gold Leaf Co., Providence, R. I.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
American Steel Foundries, Chicago, Ill.
American Tool Works Co., Cincinnati, O.
Anchor Packing Co., Pittsburgh, Pa.
Armstrong-Blum Mfg. Co., Chicago, Ill.
Ashton Valve Co., Chicago, Ill.
Baker Bros., Toledo, O.
Barco Brass & Joint Co., Chicago, Ill.
Baush Machine Tool Co., Springfield, Mass.
Besly, Chas. H. & Co., Chicago, Ill.
Bettendorf Co., Bettendorf, Iowa.
Bird-Archer Co., New York City.
Blackall, Robert H., Pittsburgh, Pa.
Boker, Herman & Co., Brooklyn, N. Y.
Bowser, S. F. & Co., Fort Wayne, Ind.
Brown Automatic Hose Coupling Co., Toledo, O.
Brubaker, W. L. & Bros., Millersburg, Pa.
Buckeye Steel Castings Co., Columbus, O.
Buffalo Brake Beam Co., New York City.
Camel Co., Chicago, Ill.
Carborundum Co., Niagara Falls, N. Y.
Carnegie Steel Co., Pittsburgh, Pa.
Cayuta Mfg. Co., Sayre, Pa.
Chase, L. C. & Co., Boston, Mass.
Chicago Car Heating Co., Chicago, Ill.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chicago Railway Equipment Co., Chicago, Ill.
Chicago Varnish Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cincinnati Bickford Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Cincinnati Planer Co., Cincinnati, O.
Clark Foundry Co., Rumford, Me.
Coe, W. H. Mfg. Co., Providence, R. I.
Commercial Acetylene Ry. L. & S. Co., New York City.
Commonwealth Steel Co., St. Louis, Mo.
Consolidated Car Heating Co., Albany, N. Y.
Consolidated Ry. Elec. Lgt. & Eqpt. Co., New York City.



Boiler Test Pump.

Cooper-Hewitt Electric Co., Hoboken, N. J.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Curtain Supply Co., Chicago, Ill.
Damascus Brake Beam Co., Cleveland, O.
Dazie Mfg. & Supply Co., New York City.
Dearborn Chemical Co., Chicago, Ill.
Deforest Sheet & Tinplate Co., Niles, Ohio.
Detroit Lubricator Co., Detroit, Mich.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Draper Mfg. Co., Port Huron, Mich.
Dressel Railway Lamp Wks., New York City.
Duff Mfg. Co., Pittsburgh, Pa.
DuPont Fabrikoid Co., Inc., Wilmington, Del.
Eagle Glass & Mfg. Co., Wellsburg, W. Va.
Economy Devices Corp., New York City.
E. D. E. Company, Chicago, Ill.
Edison Storage Battery Co., Orange, N. J.
Edwards, O. M., Co., Syracuse, N. Y.
Electric Controller & Mfg. Co., New York City.
Electric Storage Battery Co., Philadelphia, Pa.
Elwell-Parker Electric Co., New York City.
Equipment Improvement Co., New York City.
Fastnut, Limited, London, Eng.
Flannery Bolt Co., Pittsburgh, Pa.
Forged Steel Wheel Co., Pittsburgh, Pa.
Fort Pitt Malleable Iron Co., Pittsburgh, Pa.
Foster, Walter H. Co., New York City.
Franklin Railway Supply Co., New York City.
Frost Railway Supply Co., Detroit, Mich.
Galena Signal Oil Co., New York City.
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Schenectady, N. Y.
General Railway Supply Co., Chicago, Ill.
Gold Car Heating & Lighting Co., New York City.
Goldschmidt Thermit Co., New York City.
Gould Coupler Co., New York City.
Greene, Tweed & Co., Chicago, Ill.
Griffin Wheel Co., Chicago, Ill.
Grip Nut Co., Chicago, Ill.
Hale & Kilburn Co., New York City.
Hammett, H. G., Troy, N. Y.
Harrington, Edwin, Son & Co., Inc., Philadelphia, Pa.
Hartshorn, Stewart Co., Chicago, Ill.
Heppenstall Forge & Knife Co., Pittsburgh, Pa.
Hewitt, H. H., New York City.
Hewitt Rubber Co., Buffalo, N. Y.
Heywood Bros. & Wakefield Co., Wakefield, Mass.
Hunt-Spiller Mfg. Corp., So. Boston, Mass.
Hutchins Car Roofing Co., Detroit, Mich.
Illinois Steel Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York City.
Jacobs-Shupert U. S. Firebox Co., New York City.
Jenkins Bros., New York City.
Johns, H. W., Mannville Co., New York City.
Joliet Railway Supply Co., Chicago, Ill.
Jones & Lamson Machine Co., Springfield, Vt.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Justice, Phillip S. & Co., Philadelphia, Pa.
Kerite Insulated Wire & Cable Co., New York City.
Keyoke Railway Equipment Co., Chicago, Ill.
Keystone Lubricating Co., Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Lehon Co., Chicago, Ill.
Locomotive Stoker Co., Schenectady, N. Y.
Locomotive Superheater Co., New York City.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
Long, Chas. R., Jr., Co., Louisville, Ky.
Lunkenheimer Co., Cincinnati, O.
Lutz-Webster Engineering Co., Philadelphia, Pa.
Magnus Metal Co., New York City.
Mahr Mfg. Co., Minneapolis, Minn.
Manning-Maxwell & Moore, Inc., New York City.
Massachusetts Mohair Plush Co., Boston, Mass.
Midvale Steel Co., Philadelphia, Pa.
Mudge & Co., Chicago, Ill.
McConway & Torley Co., Pittsburgh, Pa.
McCord & Co., Chicago, Ill.
McCord Mfg. Co., Chicago, Ill.
McGraw Publishing Co., New York City.
Nathan Mfg. Co., New York City.
National Graphite Lubricator Co., Scranton, Pa.
National Lock Washer Co., Newark, N. J.
National Malleable Castings Co., Cleveland, O.
National Tube Co., Pittsburgh, Pa.
Newhall, Geo. M., Engineering Co., Philadelphia, Pa.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York City.
Norton, A. O., Inc., Boston, Mass.
Nuttall, R. D. Co., Pittsburgh, Pa.
Okonite Company, New York City.
O'Malley-Beare Valve Co., Chicago, Ill.
Pantasote Co., New York City.
Parkesburg Iron Co., Parkesburg, Pa.
Pels, Henry & Co., New York City.
Pilliod Co., Swanton, O.
Pocket List of RR. Officials, New York City.
Pollak Steel Co., New York City.
Power Specialty Co., New York City.
Pressed Steel Car Co., Pittsburgh, Pa.
Pyle National Electric Headlight Co., Chicago, Ill.
Pyrene Mfg. Co., New York City.
Quigley Furnace & Foundry Co., New York City.
Railway Electrical Engineer, Chicago, Ill.
Railway List Co., Chicago, Ill.
Railway Materials Co., Chicago, Ill.
Railway Review, Chicago, Ill.
Railway Utility Co., Chicago, Ill.
Ralston Steel Car Co., Pittsburgh, Pa.
Reading Specialties Co., Reading, Pa.
Reed Mfg. Co., Erie, Pa.
Reliance Electric & Engineering Co., Cleveland, O.
Remy Electric Co., Anderson, Ind.
Robinson Co., Boston, Mass.
Rochester Germicide Co., Rochester, N. Y.
Ross Schofield Co., New York City.
Ryerson, Joseph T., & Son, New York.
Safety Car Ht'g & Lt'g Co., Chicago, Ill.
Sargent Co., Chicago, Ill.
Sellers, Wm., & Co., Philadelphia, Pa.
Simmons-Boardman Publishing Co., New York City.
Standard Asphalt & Rubber Co., Chicago, Ill.
Standard Heat & Ventilation Co., New York City.
Standard Steel Car Co., Pittsburg, Pa.
Standard Stoker Co., Inc., New York City.
Strong-Carlisle & Hammond Co., Cleveland, O.
Symington, T. H., Co., Rochester, N. Y.
Transportation Utilities Co., New York City.
Union Draft Gear Co., Chicago, Ill.
Union Railway Equipment Co., Chicago, Ill.
Union Spring & Mfg. Co., Pittsburgh, Pa.
United Engineering & Fndry. Co., Pittsburgh, Pa.
U. S. Light & Heating Co., New York City.
U. S. Metal & Mfg. Co., New York City.
U. S. Metallic Packing Co., Philadelphia, Pa.
Universal Draft Gear Attachment Co., Chicago, Ill.
Valentine & Co., New York City.
Vissering, Harry & Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, O.
Watson-Stillman Co., Union County, N. J.

West Disinfecting Co., New York City.
Western Ry. Equipment Co., St. Louis, Mo.
Western Steel Car & Fndry. Co., Chicago, Ill.
Westinghouse Air Brake Co., E. Pittsburgh, Pa.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Westinghouse Machine Co., E. Pittsburgh, Pa.
Wheel Truing Brake & Shoe Co., Detroit, Mich.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wilmarth & Norman Co., Grand Rapids, Mich.
Wilson Remover Co., Newark, N. J.
Wiltbonco Mfg. Co., Boston, Mass.
Wine Railway Appliance Co., Toledo, O.
Yale & Towne Mfg. Co., New York City.
Zug Iron & Steel Co., Pittsburgh, Pa.

Personals

W. B. Kilgore has been appointed road foreman of engines of the *Baltimore & Ohio,* with office at Lima, O., and with jurisdiction between Troy and Cincinnati.

A. E. McMillan has been appointed assistant master mechanic of the *Baltimore & Ohio Southwestern,* with office at Cincinnati, O.

J. B. Harward succeeds W. H. Keller as general foreman of the *Baltimore & Ohio Southwestern* at Flora, Ill.

Oscar Stevens succeeds W. C. Garaghty as road foreman of engines of the *Baltimore & Ohio Southwestern* at Cincinnati, O.

William Graff has been appointed road foreman of engines of the *Baltimore & Ohio Southwestern* at Chillicothe, O.

J. S. Sheafe has been appointed master mechanic of the *Baltimore & Ohio* at Clifton (S. I.), N. Y. Mr. Sheafe was formerly engineer of tests of the Illinois Central at Chicago.

H. A. Martin succeeds S. D. Page as general car foreman of the *Bangor & Aroostock,* with office at Milo Junction, Me.

F. G. Drolet succeeds S. L. Tracy as general engine foreman of the *Bangor & Aroostock* at Milo Junction, Me.

W. W. Boulineau has been appointed road foreman of the *Central of Georgia* at Macon, Ga., succeeding A. D. Prendergast.

A. G. McLellan succeeds W. H. Wunderlee as foreman of locomotive repairs of the *Chicago & Alton* at Bloomington, Ill.

W. H. Naylor succeeds W. H. Davies as road foreman of engines of the *Chicago & Alton,* with offices at Bloomington, Ill.

Howard Timmel, road foreman of the *Chicago, Burlington & Quincy,* has been transferred from Sterling, Colo., to Edgemont, S. D., where he succeeds E. R. Morrison.

F. Carter has been appointed purchasing agent of the *Chicago & Illinois Midland,* succeeding H. F. Campbell. His office is at Chicago.

F. W. Murphy succeeds John Bauer as master mechanic of the *Chicago, Ottawa & Peoria,* with office at Ottawa, Ill.

F. Fisher succeeds W. H. Cour as general foreman of the *Chicago, Peoria & St. Louis.* His office is at Springfield, Ill.

W. H. Keller succeeds W. A. Deems as general foreman of the *Cincinnati, Hamilton & Dayton* at Lima, O.

John Simmes has been appointed general foreman of the *Cincinnati, New Orleans & Texas Pacific* at Ludlow, Ky., succeeding J. G. Lewis.

D. J. Mullen has been appointed superintendent of motive power of the *Cleveland, Cincinnati, Chicago & St. Louis,* succeeding S. K. Dickerson. His office is at Indianapolis, Ind.

F. K. Murphy succeeds D. J. Mullen as assistant superintendent of motive power of the *Cleveland, Cincinnati, Chicago & St. Louis,* with office at Indianapolis, Ind.

W. E. Ricketson succeeds C. A. Brandt as mechanical engineer of the *Cleveland, Cincinnati, Chicago & St. Louis,* with office at Beech Grove, Ind.

F. Bauer succeeds F. K. Murphy as master mechanic of the *Cleveland, Cincinnati, Chicago & St. Louis,* with office at Indianapolis, Ind.

C. A. Brandt has been appointed assistant master mechanic of the *Cleveland, Cincinnati, Chicago & St. Louis,* with office at Indianapolis, Ind. Mr. Brandt was formerly mechanical engineer.

W. E. Lefaivre succeeds Thomas Tipton as purchasing agent of the *Denver & Rio Grande,* with office at Denver, Colo.

B. Ferris has been appointed acting general foreman of the *Detroit, Toledo & Ironton* at Delray, Mich., succeeding George Gilmore.

H. Allen succeeds William Russell as foreman car repairs of the *Galveston, Harrisburg & San Antonio* at El Paso, Tex.

F. A. Bladorn succeeds J. D. Brown as locomotive foreman of the *Great Northern* at Billings, Mont.

D. P. Phalen succeeds H. G. Koch as locomotive foreman of the *Great Northern* at Butte, Mont.

W. P. Milon succeeds R. E. Molt as locomotive foreman of the *Great Uorthern* at Whitefish, Mont.

F. Heins has been appointed master mechanic of the *Gulf & Sabine River,* vice C. E. Magee. His headquarters are at Fullerton, La.

Charles F. Barnhill, as announced in our last issue, has been appointed master mechanic of the *Gulf, Colorado & Santa Fe,* with office at Silsbee, Tex. Mr. Barnhill was born on December 26, 1872, at McArthur, O., and entered railway service in October, 1886, as a machinist apprentice with the Ohio Southern Railway. He completed his apprenticeship in 1891 and worked in various shops as a machinist during the following two years. From 1893 to 1898 he was successively machine foreman, erecting foreman and general foreman at the Clifton Forge shops of the Chesapeake & Ohio. From 1898 to 1900 he was erecting foreman for the same road at Huntington, W. Va., later going to the Columbus, Shawnee & Hocking as machine and erecting foreman. In 1902 he became erecting foreman of the Gulf, Colorado & Santa Fe at Cleburne, Tex., and from 1904 to 1907 was roundhouse foreman at the same point. In March, 1907, he was made division foreman of the same road at Gainesville, Tex., which position he held until his recent appointment.

H. B. Brown, formerly assistant superintendent of machinery of the *Illinois Central,* is now general fuel inspector of that road, with headquarters at Park Row Station, Chicago.

W. G. Hall, as announced in the February issue, has been appointed master mechanic of the *International & Great Northern* at Mart, Tex. Mr. Hall was born at Palestine, Tex., in 1882, was educated in the public schools at that place and commenced railway work as a machinist apprentice with the International & Great Northern in October, 1898. Upon completing his apprenticeship in October, 1902, he took service with the St. Louis, Iron Mountain & Southern at Argenta, Ark., as a machinist, later going with the St. Louis Southwestern at Pine Bluff, Ark., and

W. G. HALL.

with the Chicago & Eastern Illinois at Danville, Ill., where he was made gang foreman in August, 1905. In December, 1907, he became roundhouse foreman of the Trinity & Brazos Valley at Teague, Tex. In January, 1910, he was made roundhouse foreman of the International & Great Northern at Palestine, Tex., holding this position until his recent promotion.

C. E. FOWLER has been appointed master mechanic of the *Jefferson & Northwestern*, with office at Jefferson, Tex. He succeeds T. H. Y. Newcomb.

CHARLES WOODARD succeeds C. L. Adair as master mechanic of the *Kansas City, Mexico & Orient of Texas*, with office at San Angelo, Tex.

W. M. BOSWORTH, whose appointment as mechanical engineer of the *Louisville & Nashville* was announced in the last issue, was born June 13, 1879, at Baltimore, Md. He commenced railway work in July, 1898, as a special apprentice at the Mount Clare shops of the Baltimore & Ohio and later became a draftsman at the same place. From 1906 until 1911 he was chief draftsman of the Baltimore & Ohio and in 1911 was appointed mechanical engineer of the Kansas City Southern at Pittsburg, Kan., where he remained until his present appointment.

B. J. PEASLEY has been appointed superintendent of shops of the *Missouri Pacific* at Argenta, Ark. He succeeds B. E. Stevens.

G. K. STEWART succeeds B. J. Peasley as master mechanic of the *Missouri Pacific* at DeSoto, Mo.

J. A. SHEPPARD has been appointed master mechanic of the *Missouri Pacific* shops at Coffeyville, Kan., succeeding G. K. Stewart. Mr. Sheppard was born at Clinton, Ia., on August 14, 1867, serving his apprenticeship on the Chicago & Northwestern at that point. After completing his apprenticeship he served with the Chicago, Milwaukee & St. Paul at Savanna, Ill., with the Duluth & Iron Range at Two Harbors, Minn., and with the Clinton Bridge & Iron Works at Clinton, Ia. Later he was with the B. C. R. Railway at Cedar Rapids, Ia., as machinist and foreman. He left Cedar Rapids on December 1, 1908, to become division foreman of the Missouri Pacific at Council Grove, Kan., and in the spring of 1911 was transferred to the same position at Pueblo, Colo., where he remained until his present appointment.

J. L. WOODS has been appointed assistant purchasing agent of the *Nashville, Chattanooga & St. Louis*, with office at Nashville, Tenn.

I. M. RAMSDELL has been appointed master car builder of the *Oregon-Washington R. R. & N.*, with office at Portland, Ore. Mr. Ramsdell was formerly master car builder of the Chicago & Alton at Bloomington, Ill.

L. WOSTER succeeds F. Ritner as superintendent of motive power of the *Ohio Southeastern*, with office at Cincinnati, O.

J. C. NOLAN has been appointed master mechanic of the *St. Louis, Brownsville & Texas*, with office at Kingsville, Tex.

A. F. HAWKINS has been appointed general foreman, car department, of the *San Antonio, Uvalde & Gulf*, with headquarters at Pleasanton, Tex., vice W. H. Pinson, resigned.

H. JACKSON has been appointed general foreman, locomotive department, of the *San Antonio, Uvalde & Gulf*, with headquarters at Pleasanton, Tex., vice H. M. Warden, resigned.

J. H. RUXTON has been appointed superintendent of motive power of the *San Antonio, Uvalde & Gulf*, with headquarters at Pleasanton, Tex.

GEORGE ST. PIERRE has been appointed superintendent of equipment of the *San Francisco-Oakland Terminal*, with office at Oakland, Cal. He was formerly master mechanic at that point.

J. J. ROBINSON succeeds S. C. Shepperd as general foreman of the *Southern* at Manchester, Va.

C. E. KEEVER succeeds J. J. Robinson as general foreman of the *Southern* at Greenville, S. C.

F. A. BALICH succeeds A. L. Stewart as general foreman of the *Southern* at Charlotte, N. C.

T. W. HEINTZELMAN, as announced in our last issue, has been appointed general superintendent of motive power of the *Southern*

T. W. HEINTZELMAN.

Pacific, with headquarters at San Francisco, Cal. Mr. Heintzelman commenced railway work as a machinist apprentice, following it up with a term in the draughting room and afterwards being promoted to foreman in the machine shop. He then gave up shop work and entered road service as a fireman and later as a locomotive engineer. Subsequently he was made general foreman and assistant master mechanic on the Chicago, St. Paul, Minneapolis & Omaha and then master mechanic on the Chicago, St. Paul & Kansas City (now the Chicago Great Western). He remained with this road until he took service with the Southern Pacific as master mechanic at Sacramento in 1888. In 1902 he was promoted to superintendent of motive power of the northern district of this company, occupying this position until his present promotion.

O. B. SCHOENKY has been appointed shop superintendent of the *Southern Pacific* at Sacramento, Cal., succeeding C. T. Noyes.

D. S. WATKINS has been promoted to assistant superintendent of shops of the *Southern Pacific* at Sacramento, Cal.

J. P. BRENDEL succeeds O. B. Schoenky as general foreman of the car shops of the *Southern Pacific* at Sacramento, Cal.

F. M. MASELEY has been appointed roundhouse foreman of the *Texas & Gulf*, succeeding R. J. Wilson. His office is at Longview, Tex.

P. STEFFIAN has been appointed purchasing agent of the *Vera Cruz Terminal*, with office at Mexico City, Mexico.

F. T. HYNDMAN, superintendent of motive power of the *Wheeling & Lake Erie*, has had his headquarters transferred from Cleveland to Brewster, O.

F. CLARKE has been appointed locomotive foreman of the *Canadian Northern* at Calgary, Alta.

A. H. SWEETMAN has been appointed car foreman of the *Canadian Northern* at North Battleford, Sask.

H. THOMPSON succeeds J. Quinn as locomotive foreman of the *Canadian Northern Ontario*, with office at Parry Sound, Ont.

A. H. BINNS succeeds L. F. Hamilton as master mechanic of the Ontario division of the *Canadian Pacific*, with headquarters at West Toronto, Ont.

F. W. NICKS has been appointed acting master mechanic of the Manitoba division of the *Canadian Pacific*, with office at Winnipeg, vice P. S. Lindsay, on leave of absence.

M. S. MONTGOMERY has been appointed road foreman of the *Northern Pacific* at Duluth, Minn.

B. F. LILLY succeeds W. L. Jones as general foreman, car department, of the *St. Louis, Brownsville & Mexico*, with office at Kingsville, Tex.

OBITUARY.

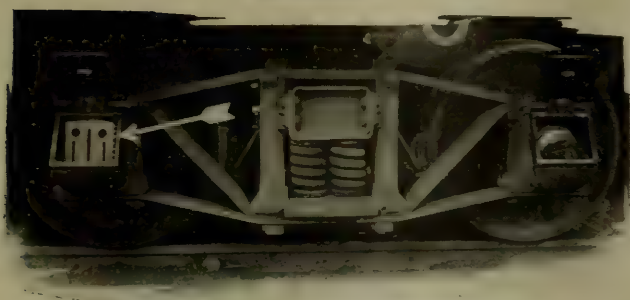
WILLIAM APPE, at one time master car builder on the *Canadian Pacific* and later holding the same position on the *Algoma Central & Hudson Bay*, died at his home at Toronto, March 21, at the age of 67.

D. C. FITZGERALD, former assistant superintendent of motive power of the *St. Louis & San Francisco*, lost his life in the fire which destroyed the Missouri Athletic Club at St. Louis, Mo., on March 9.

Among The Manufacturers

JOURNAL BOX PACKING GUARD.

Robbing journal boxes of waste for use in starting fires, oiling small machines, etc., has resulted in a good many cases of delay to trains due to hot boxes, with the attendant danger, and also in the injuring or destruction of the journal brasses. To prevent this source of loss, annoyance and possible danger, a device has just been perfected and placed on the market called the Nuway journal box packing guard. This is in the form of a plate made of 14 gauge steel with teeth on sides and bottom, designed so that the waste cannot work out at the front of the journal box and also so that waste is retained absolutely against the efforts of anyone to extract it from the box.



Journal Box at Left is Equipped with Nuway Packing Guard. The One at the Right Is Not So Equipped.

The guard is held in place by the weight of the car, so that there is no possibility of tampering or removing the guard without lifting the car. This device, therefore, absolutely insures the lubrication of the axle at the heaviest bearing point at all times, provided there is any oil whatever left in the packing—this in addition to saving a large amount of waste. An element of additional safety is provided for the proper operation of cars without boxes running hot. This journal box packing guard is being marketed by the Nuway Packing Guard Co., Tuscaloosa, Ala.

HANCOCK COAL SPRINKLER.

Many accidents in a locomotive cab are due to the failure of the coal sprinkling apparatus. Water for sprinkling is usually taken from the delivery pipe of the injector, and the temperature is so high and the pressure so great that when the delivery hose becomes clogged, as it frequently does as a result of the heat and pressure destroying the inner lining, the hose either bursts or is blown off the connection, scalding the occupants of the cab. Of all cab accidents 70 per cent are said to come from this source.

The Hancock sprinkler, which acts on the principle of an ejector, is so designed that it is absolutely proof against accidents of this kind.

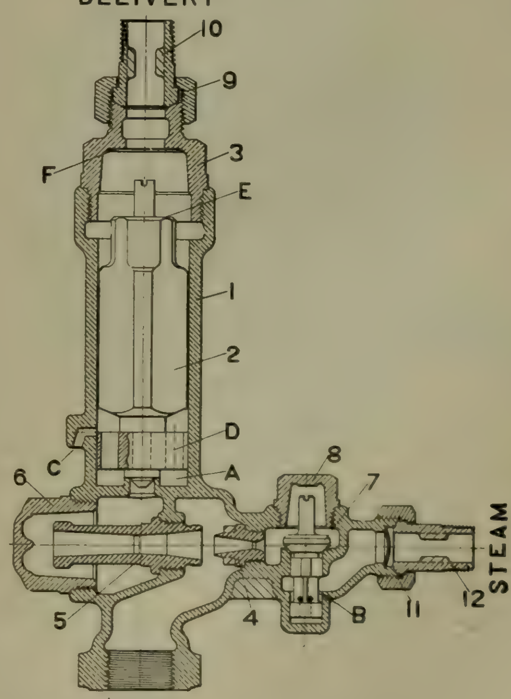
The principle feature of the Hancock coal sprinkler, made by the Hancock Inspirator Co., New York, is a valve which automatically discriminates between steam and water, and its action is so positive and reliable that there cannot be a sudden and unexpected discharge of steam through the hose.

The sprinkler is generally applied on the strainer or on the suction valve of the injector of the locomotive by the use of a short connecting nipple having a bend so that the sprinkler will be in a vertical position. A valve is placed in the steam pipe at a point where it can be conveniently reached.

In operating the coal sprinkler the steam valve in the pipe is opened wide and that action opens the valve 7. That action also closes the drip hole B, the piston end on the lower end of guiding stem covering the hole. Steam will now flow through nozzle No. 4, forming a jet and combining with water in valve 5. (But there never will be a flow of steam in starting because tubes 4 and 5 are always under water by reason of the location of the sprinkler at a point lower than the tank.)

Steam will flow into the pressure chamber A and valve 2, which has been closed heretofore, will be lifted. Port C, which has been opened heretofore, will also be closed and the water will be forced through the delivery pipe and into the delivery hose.

The accidents resulting from the use of a sprinkler have generally been caused by an interruption of the water supply, due to an obstruction, such as leaves, waste or coal at the strainer, or by the failure of the injector to work. Should the flow of water be interrupted or the injector refuse to work, where a Hancock coal sprinkler is used, the valve No. 2 which discriminates between steam and water will close the sprinkler so that no steam will escape into the hose; instead the steam will be blown back toward the suction pipe, will flow into the



Hancock Coal Sprinkler.

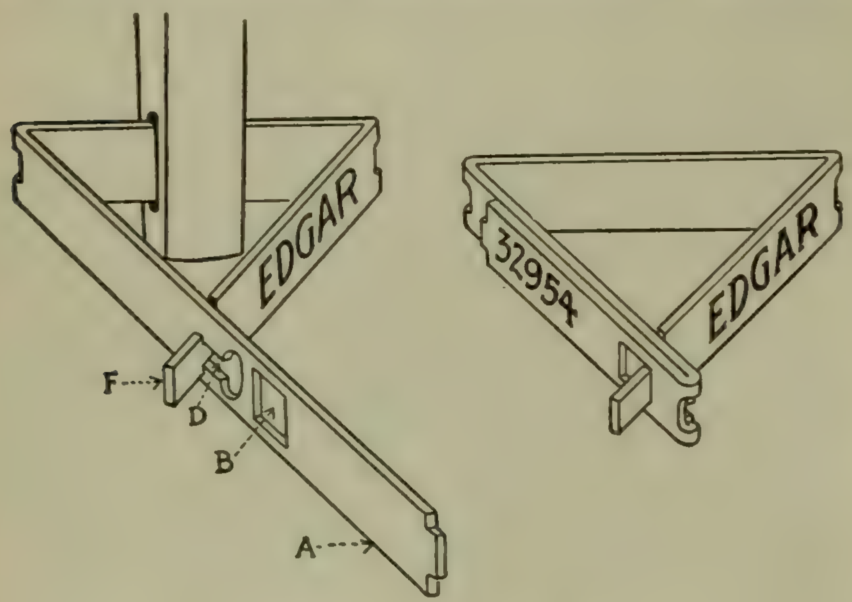
pressure chamber A and force valve 2 upward. The end E of valve 2 will seat against the surface F, thus making it impossible for steam to flow into the delivery tube.

When not operating both valves will seat. The discriminating valve No. 2 is heavy enough to prevent water flowing up the delivery pipe and then all the water in the delivery pipe will flow out of the drain hole C. At the same time steam valve 7 will seat, no water will flow up the steam pipe and all water or steam in the steam pipe will drain out at the hole B.

This sprinkler uses comparatively cold water; no steam can escape; it is self-draining and cannot freeze.

CAR SEAL.

The metal car seal shown in the illustration is made of two-ply steel, punched so that it can easily be bent in the shape of a triangle and locked by turning one of the ends back, as shown in one of the figures. An attempt to unlock the seal will break off this end, as the metal of the seal will not stand up under rebending, due to its composition. The seal of the car is thereby broken. The seal is put through the slot in the door pin, is bent at the two punched holes in the manner shown and the end F is inserted and pressed down into slot D. The narrow



Application of Edgar Car Seal.

portion of the end F fits into this slot. The end A is then bent at the entrance to slot D, until F passes through the square hole B. If the numbered end is raised enough to allow the F end to be slipped out of the slot, the numbered end will invariably break off. The seal can be used with the hasp and staple without a pin, and with a two-pin hook it is only necessary to put the seal through one pin. When sealing through a horizontal slot the seal should be applied with the number on the lower side so that it may be easily read. The seal has been placed on the market by the Metal Car Seal Co. of Chicago, Ill.

New Literature

The Gold Car Heating & Lighting Co. of New York has just issued a booklet descriptive of Gold's electric thermostatic control of steam heating. This is an economical method of controlling the steam, maintaining an equable temperature in every car throughout the train, lessening the parts and weight of the steam heating system, and cutting down the steam consumption both in yards, at terminals, and in service.

* * *

"A Manual of Electrical Testing" is the subject of a new forty-eight page bulletin, issued by the Wagner Electric Manufacturing Co. of St. Louis. Besides describing the line of portable instruments manufactured by the Wagner company, this bulletin describes various types of electrical instrument movements, the errors to which they are subject and gives suggestions for their handling and care. The methods for making tests on alternating current and direct current motors and generators and on transformers are described at length and illustrated by comprehensive and instructive diagrams.

* * *

Locomotive hoists as manufactured by the Whiting Foundry Equipment Co., Harvey, Ill., are fully described in catalogue No. 105 of that firm. They are of the electric screw jack type, the mechanism consisting principally of two stationary and two movable screw jacks located in pairs on opposite side of railroad track on which locomotive to be wheeled is run. Illustrations of a number of installations are given.

* * *

The National Malleable Castings Co. has issued circulars No. 65 and No. 66, covering respectively the National safety brake lever and the National safety clevis and pin for uncoupling rods.

* * *

"National" Bulletin No. 11B of the National Tube Co., Pittsburgh, Pa., contains some 27 pages of the history, characteristics and advantages of "National" pipe. Considerable research work was necessary to secure some of the information and the booklet is interesting and valuable.

* * *

The Waterhouse Welding Co. of Boston, Mass., has published a booklet entitled "Welding and Cutting Plants," containing illustrations, details and prices of six different outfits of this sort which are furnished by this firm.

* * *

A. L. Henderer's Sons of Wilmington, Del., have issued their 1914 catalogue, which is divided into a tube expander section, a punch section, a pump section and a jack section. A complete line of tools is shown in each section.

The Selling Side

James T. Gardner, for a number of years in the railway supply business, with offices in the Railway Exchange building, Chicago, died on April 9 at his home in Chicago. Mr. Gardner spent many years in railway service, being successively superintendent of the Buffalo, New York & Philadelphia; general superintendent of the Buffalo, Rochester & Pittsburgh, and general manager of the Cincinnati, Saginaw & Mackinac. He has been in the railway equipment business since 1891.

The Joyce-Watkins Company has removed its office from 134 South La Salle street, Chicago, to the McCormick building, 332 South Michigan avenue.

The U. S. Light & Heating Co. has moved its Chicago office from 1013 Peoples Gas building to 2335 State street, thus bringing the Chicago sales office and service station into the same building.

The Scarritt-Comstock Furniture Co., St. Louis, has been incorporated as the Scarritt-Comstock Corporation.

The A. S. Cameron Steam Pump Works, New York, has opened a branch office and warehouse in each of the following cities: Birmingham, Ala.; Chicago; Cleveland, Ohio; Duluth, Minn.; Houghton, Mich.; Knoxville, Tenn.; Los Angeles, Cal.; Philadelphia, Pa.; Pittsburgh, Pa.; St. Louis, Mo.; Seattle, Wash.

The Dieter Nut Company has moved its offices from 84 William street, New York, to 80 Maiden Lane.

J. T. Anthony has been appointed assistant general eastern sales manager of the American Arch Company. Mr. Anthony was born in February, 1883, was graduated at Georgia Tech. in 1902, and was engaged in textile manufacturing for four years; entered the service of the Atlantic Coast Line in 1906, and changed to the Central of Georgia in January, 1907, being located in the motive power department. He took the position of combustion engineer with the American Arch Co. in January, 1912, and was made

J. T. ANTHONY.

assistant to president in January, 1913, which position he held until March 1, 1914, when he was appointed to his present position.

HARLOW D. SAVAGE has been appointed general eastern sales manager of the American Arch Co., with office at 30 Church street, New York. Mr. Savage was born at Memphis, Tenn., April 16, 1860, and was educated in the public schools and at Kenyon Mili-

H. D. SAVAGE.

tary Academy. From June, 1907, to March 1, 1914, he was with the Ashland Fire Brick Co.

W. L. ANDERSON has been appointed manager of the railway sales department of the Union Fibre Company, Chicago. He was formerly with George E. Molleson Co.

EDWARD A. HAWKS has been appointed a special representative of the department of car equipment of Dahlstrom Metallic Door Co., Jamestown, N. Y.

FRANK J. SCHRAEDER, JR., formerly with the Roberts & Schaefer Company, Chicago, has formed a partnership with R. E. Gurley, formerly with the T. W. Snow Construction Company. The firm will be known as Gurley & Schraeder, with offices in the Ellsworth building, Chicago.

G. W. ALDEN, formerly with the McMyler-Interstate Co., of Bedford, Ohio, has been appointed western sales manager for the Ohio Locomotive Crane Co., of Bucyrus, Ohio, with office in the Fisher building, Chicago.

ARTHUR J. ODEGAARD, manager of the St. Louis office of the Spencer Otis Co., and former assistant purchasing agent of the Rock Island Lines, was killed in the fire which destroyed the Missouri Athletic Club in St. Louis, Mo., on March 9.

I. W. LINCOLN has been appointed vice president of the Duncan Lumber Company, of Portland, Ore. He is in charge of the eastern sales office in the McCormick building, Chicago.

BERTRAM SMITH has been appointed assistant manager of the Edison Storage Battery Supply Company, San Francisco, which handles the Edison battery on the Pacific coast.

W. K. ALLEN, formerly secretary of the Elgin, Joliet & Eastern, has been made general western agent of the Hudson Mechanical Rubber Company, 50 Church street, New York, and the United Railway Signal Company, Trenton, N. J., with office in the People's Gas building, Chicago.

GEORGE HILLS has resigned as president of the Welding Materials Co., New York, to become general sales agent of the Siemund Wenzel Electric Company, of New York.

FRANK N. GREGG has been appointed sales agent of the Transportation Utilities Company, with office at 1201 Virginia Railway & Power building, Richmond, Va.

THE BARCO BRASS & JOINT CO., 226 North Jefferson street, Chicago, in order to take care of its increasing business, has engaged the services of Clarence L. Mellor, who was formerly with the United States Metallic Packing Co., in charge of western sales, and has appointed Mr. Mellor western representative. Mr. Mellor has been in the railway supply business a number of years. From 1897 to 1899 he was in the London

C. L. MELLOR,
Barco Brass & Joint Co., Chicago.

office of Edward Mahoney; he at that time represented the Baldwin Locomotive Works, Harlin & Hollingsworth, Edgemore Bridge Works, etc. He returned to the United States in 1899 and was with the Baldwin Locomotive Works as foreman in various departments until 1909, when he went with Alfred Lowell as chief inspector. He remained there a few months and then went with the United States Metallic Packing Co., whom he has represented in the west ever since.

REOPENING OF THE SOUTHERN HOTEL.

The Southern Hotel at St. Louis, which was one of the best known and most popular with railroad men, is to be reopened on May 1 on a strictly modern and high-class basis and will be operated along the same lines which made it so popular in days past. The original Southern Hotel was built by Thomas Allen, but was destroyed by fire in 1877. Allen then determined to build a hotel which could not be burned, and in building the new hotel, steel rails and stone were used. This building was erected in 1880. Since that time many prominent men have been entertained under its roof. The St. Louis Railway Club held its meetings there for many years and there is now quite a favorable sentiment being shown towards holding its meetings there in the future.

The hotel has 350 guest rooms and is to be operated on the European plan exclusively. The Missouri Athletic Club has engaged quarters on the ground floor for two years and this of course will serve to add to the popularity of the hotel.

JACK RYAN.

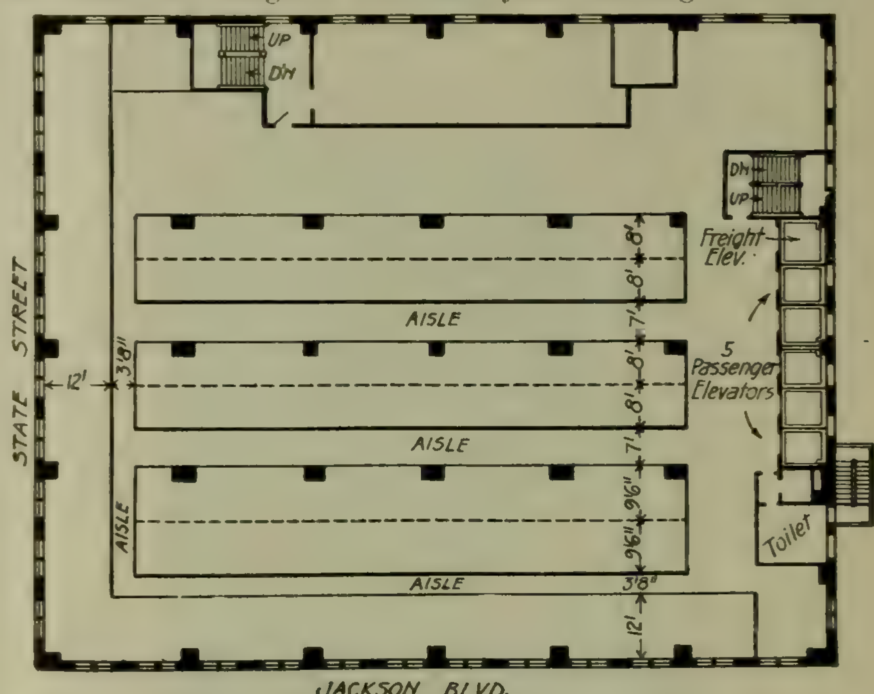
The new officers are: Walter Powell, president; Joseph Turley, secretary and treasurer, and ''Jack'' Ryan, manager. ''Jack'' Ryan will be well remembered by the former patrons of the hotel as he has been connected with it since 1888, with the exception of two or three years. Ryan is always there with ever present good cheer and hospitality and no one need be blue while he is on the job. The reopening of this hotel will undoubtedly meet with a great favor among supply and railway men as well as others.

RAILWAY SUPPLY EXHIBIT IN NEW QUARTERS.

Some two years ago the Karpen brothers conceived the idea of fitting up an entire floor of their spacious building at 900 Michigan avenue, Chicago, for a concentrated and collective exhibit of railway supplies and equipment, and to this end equipped the twelfth floor with the necessary telephones, furniture, etc., which would make it possible for anyone interested in this industry to have every possible convenience afforded by a modern office in addition to having their product on exhibit the year round to visiting railroad men. The past two years has proven that the idea was thoroughly practical, and that many of the manufacturers who had salesrooms and offices in Chicago recognized the importance of having their goods displayed on the floor and rented space for that purpose, but the only thing that hindered the rapid growth of the plan was the location of the Karpen building—its distance from the loop prevented many visiting railroad men from attending it, owing to lack of time, and resident railroad men could not spare time during business hours to visit it.

Lytton Building.

To overcome this and bring the idea to a full fruition, the management perfected arrangements to occupy the entire ninth floor of the new Lytton building, corner State street and Jackson boulevard, on and after April 1st. No expense has been spared to make the floor attractive and comfortable to tenants and visitors alike. Elaborate grill room facilities have been planned and many improvements, born of the knowledge gleaned from past experience, will be made. Allen Sheldon, who has been in active charge of the exhibit at the Karpen building, will have full charge of it at the Lytton building.



Floor Plan of Railway Supply Permanent Exhibit.

This plan offers railway supply manufacturers, railway supply representatives and in fact anyone interested in the sale of their products to railroads an exceptional opportunity to keep their goods constantly before the eyes of interested railroad men. It also offers office facilities in the very heart of the railway supply industry at a cost far below the maintenance of individual offices, with the distinct advantage of having the buyers brought to their door instead of having to seek them.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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DALTON RISLEY, West. Mgr.

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, May, 1914 No. 5

CONTENTS.

Insulation of Steel Cars

Since the first all-steel car was placed in service, railway mechanical officers have been concerned with their insulation. The heat conductivity of steel is so much greater than that of wood, which in itself is extensively used as an insulating material, that a problem of considerable dimensions presents itself. The use of a dead air space between the outer and inner plates of the walls of steel cars was at first thought to be a means of securing reasonable insulation. When it was found that this end was not attained thereby, it appeared that the loss of heat was due to the fact that the channels uniting the outer and inner plates were responsible for the conduction of heat. To offset this an insulating material between channels and plates has been used. Difficulties of construction as principally evidenced in riveting troubles forced further consideration of the subject.

Tests now in progress at the University of Illinois seem to show that the heat losses are not so much due to the conduction of the metals in contact as to connection. In other words, the dead air space is not what it purports to be. The air in this space is in circulation—taking up heat from the inner plates rising and passing over against the outer plates, there cooling and falling to repeat the cycle. This is the most logical hypothesis and unless disproved must be acknowledged and proper steps taken to offset its effects.

The practice of rivetting through insulation between the channels and the plates with its attendant difficulties may be discontinued as not productive of any great benefit, and the air currents between the plates, broken up by filling the space with insulating material. Granulated cork is inexpensive and has been used with good results. It is probable, however, that the use of asbestos or other prepared material will be found to serve the purpose still better.

Failures in the Exploitation of New Devices

There are, roughly speaking, two kinds of failures in the exploitation of new inventions covering alleged improvements in railway construction, maintenance and operation. We presume that this statement covers the industrial field generally but are concerned only with such matters as they pertain to the railways.

We are all familiar with the type of inventor who is certain he has a wonderful patent and who, through ignorance of conditions or of business methods generally, is never able to make more than a faint start at its exploitation and ultimate adoption. He is foredoomed to failure unless he is picked up by moneyed interests, whether his invention has merit or not. He is always with us and he always interests us. He is never dangerous or seriously objectionable. His failure harms no one but himself and he is usually quick to recover.

The second class of failure is not such a harmless one. It is the result of dishonest exploitation of meritless patents. A promoter does not need a really good patent or patented article of merit to serve his purpose if he is dishonest. The promotion of a stock company is sufficient to serve his ends and in the organization of such a stock company his first move is to select a state with lax corporation laws. The device to be exploited is of secondary importance. This device must, however, be one which offers opportunity for sensational description; one the universal use of which may be described as a means for saving thousands of lives annually. The sale of a large amount of stock is the aim.

The canny promoter does not go to the officers of railway mechanical departments to sell stock in a locomotive or car device nor does he go to officers of the engineering departments to promote a track improvement. He would be handicapped in such cases by the technical knowledge of his victims. The stock sales are made among those who have seen just enough of railway work to appreciate that there is room for improvement but who have no powers of analysis which go with technical knowledge and long experience. A stock argument is the supposed interest of politicians and the prospect that the Interstate Commerce Commission will order the device universally applied in the interests of safety.

These methods hinder rather than forward real progress in the manufacture of transportation. Suspicion of anything new is fostered by experience with dishonest promotion. Were it possible to impress upon all with money to spend in this way that the advice and co-operation of the mechanical staffs of the railways is not impossible or difficult to secure for any legitimate and practical improvement in locomotive and car construction, investors would look for such evidence before spending their money. With sly winks and insinuations, however, the promoters explain the lack of such evidence in the desire of railway officers to spend no money for improvement, no matter how needed, until forced to do so.

State and federal laws will in time correct the more glaring aspects of this evil, but its complete elimination by law cannot be expected this side of the millenium. For the good of the cause, mechanical officers should not avoid opportunity to express themselves verbally or in public print in denouncing fake devices and encouragement should be unhesitatingly given where deserved.

Steel Coach Finish

There are undoubtedly some railway passengers who would feel more comfortable upon entering a modern steel coach if they could see the actual surface of the steel without a particle of paint on it and could see that the joints were well supplied with rivets. The majority of travelers, however, although they wish the sense of security which the steel coach gives, like to travel in coaches which have been painted and decorated sufficiently to make them pleasing to the eye. Service and other conditions being equal, the road which gets the business is the one which makes its depots and grounds attractive and which keeps its rolling stock in a clean and cheerful condition. The decoration of a coach is, of course, largely a matter of personal taste, but the average passenger does not like to feel that he is riding in a hearse.

Some years ago the Pullman Company established a standard of painting and decorating, consisting of a narrow line of gold along the letter-board and a wider line at the extreme lower part of the car, which added a great deal to the general attractiveness and uniform appearance of its cars. On steel coaches put in service by one or two roads recently, however, all gold stripes and other decorations have been eliminated, thus giving the coaches a very plain and unfinished appearance, which has aroused more or less unfavorable comments. The addition of a few stripes of gold leaf would brighten up these coaches immeasurably, the cost would be very slight and the effect on the traveling public would result in more fares. The steel construction is undisguisable and more effort to make it pleasing as well as utilitarian on some roads would more than recompense the slight outlay for its decoration.

The June Exhibits

Next month, from June 10 to 17, the mechanical conventions will be held at Atlantic City, and according to present indications they will be by far the most successful yet held. Many new devices and improvements will be shown on the pier, and this exhibit will be very valuable and instructive. Few unassigned exhibit spaces remain and it is expected that everything will be taken up before the convention opens. This is an opportune time to call attention to the educational value of these exhibits to those in attendance, and a careful study of them is as valuable as the meetings themselves. The supply men provide an exhibit which costs thousands of dollars to bring together and which contains everything that is of interest to the railway mechanical man, be he a car man, shop man or department head.

It is not a coincidence that the well-known, wide-awake, progressive officials may be seen on the pier after the meetings, going from booth to booth and carefully investigating what each has to show. This is the reason that these men keep at the head of the procession—they seize every opportunity to learn and they realize that such an exhibition offers them great opportunities to increase their efficiency.

Let the man who expects to attend the conventions make notes before he leaves home as to what devices are not giving him the best results, where it would be economical to install a modern machine to expedite work, up-to-date methods or processes which will bear looking into, etc., in order that he may be fully prepared to cover these points at the convention.

We do not wish to detract from the importance of the convention sessions, but to emphasize the benefits to be derived from exhibits. It is taken for granted that railway officials will attend the sessions, but there are a few who seem to regard the booths on the pier as a part of the scenery at Atlantic City which remains the same from year to year. This year, as was the case last year, the exhibits will be open certain evenings, and certainly the excuse of "no time" will not be valid. Time used in studying the exhibits will be well spent.

ATLANTIC CITY SPECIAL TRAIN.

A special train to Atlantic City over the Pennsylvania will leave the Union Station, Chicago, at 3 p. m., Monday, June 8, and will reach Atlantic City about 2 o'clock p. m. the following day. The train will be composed of steel library, smoking, sleeping and compartment observation cars, with Pennsylvania diners serving table d'hote dinner leaving Chicago, and a la carte breakfast and luncheon the following day. The summer tourist fare from Chicago to Atlantic City will be $29.50 for the round trip, good to return within 30 days. Those who desire to go to New York after the convention can purchase summer tourist tickets from Chicago to that point for $30, good to return within 30 days, and deposit them for stop-over of 10 days at Philadelphia, purchasing round-trip tickets for $2.50, Philadelphia to Atlantic City and return. The date of deposit counts as one day. Those desiring to return via Baltimore or Washington can do so, obtaining stop-over of 10 days at those points, Harrisburgh and Pittsburgh, not exceeding the final limit of the ticket, by so specifying at the time of purchasing tickets and by depositing them at stop-over points immediately on arrival,

date of deposit to count as one day. Accommodations can now be reserved at the city ticket office of the Pennsylvania Lines, 242 South Clark street, Chicago, and will be held until June 1, by which time they must be claimed, or by letter to E. K. Bixby, district passenger agent, Pennsylvania Company, Chicago.

Twenty Years Ago This Month

(From the Files.)

The plan for consolidating the American Railway Master Mechanics and the Master Car Builders' Associations is again being agitated but with little chance of success. Few persons connected with associations feel that the question is of any considerable importance.

The trials of the Westinghouse high-speed brake on the Pennsylvania were a disappointment, the wheels being slid by the heavy pressure, and the stops being longer than with the ordinary quick acting brake. The rails were in bad condition, however, and this undoubtedly contributed to the result. The trials were run with two trains on parallel tracks, one fitted with the ordinary brake equipment and the other with the new high-speed type. In each case the new brake made the longer stop.

An Adirondack railway car fitted with an electric lighting apparatus operated from the axle, was recently run over the Chicago, Milwaukee & St. Paul between Chicago and Milwaukee. The car is intended to furnish power for lighting the train in which it is hauled. It was operated for exhibition purposes by the American Railway Electric Light Co.

The Manhattan Elevated has succeeded in improving its design of Forney type engines until the excellent performance of 30 lbs. per train mile has been obtained.

The electric headlight appears to be meeting with favor on several lines, between one and two hundred now being in use. The advantages of a better lighted track, the ability to detect obstructions, misplaced switches or other dangers are in favor of the electric headlight.

The Chicago Great Western has decided to locate its shops at Oelwein, Iowa.

Geo. Gibbs, mechanical engineer of the Chicago, Milwaukee & St. Paul, has turned over to the Drexel Railway Supply Co., his device for making coil springs under cars as easy in riding qualities as are elliptic springs. The device is a simple means for dampening the action of the coil springs by means of friction plates.

The Metropolitan Elevated of Chicago has decided to adopt electric power. W. E. Baker, who was general manager of the Intramural during the World's Fair, will have charge of the electrical equipment.

The Nathan Mfg. Co., New York, has obtained the rights for this country, of the Golsdorf system of compound locomotives without starting mechanism. The chief features of this system are modification of the valve gear to such proportions that in full gear, steam will follow the piston more than 90 per cent of its stroke which avoids the necessity of any intercepting valve for preventing back pressure on the high pressure piston; and the use of auxiliary ports through which live steam is admitted to the low pressure cylinder.

The American Steel Foundry Co., has been organized with a capital of $300,000. Rolla Wells is president; E. H. Goltra, secretary and L. J. Hayward, treasurer.

The Acme Machinery Co., Cleveland, reports receipt of foreign orders traceable to the World's Fair exhibit. A large heading machine was ordered from Valparaiso, Chili, and the Hungarian State Railway at Buda Pesth has ordered two bolt cutting machines.

The Glazier Headlight Co., Rochester, has been organized to manufacture headlights, lanterns and sheet metal goods.

The Canadian Pacific has officially confirmed the rumor that it would operate its line through Kicking Horse Pass by electricity. Water power from adjacent streams will be utilized in the project.

Oil fuel for locomotives is being experimented with by the Chicago, Burlington & Quincy.

RAILWAY MAIL PAY.

Congress has passed the bill providing for the expenditures of the postoffice department for the next fiscal year. This bill, however, fails once more to compensate the railroads for carrying the parcel post. The bill is based upon estimates of the postoffice department that next year the parcel post will handle 600,000,000 packages, yielding a revenue to the postoffice of $60,000,000.

The postmaster general in his annual report of December 1, 1913, stated that in view of the prospective "prodigious growth" of the parcel post, "the railroads, of course, will become entitled to additional compensation for this extra service imposed upon them, and the department is engaged in gathering all statistical data necessary for ascertaining a correct basis for fixing a just, fair and adequate compensation for the service rendered."

On February 17th the railroads' committee was advised by the postoffice department that it had made a recommendation to congress that "on account of the increased weight of mails," due to the parcel post, the postmaster general should be authorized to add to the compensation of the railroads not more than one-half of one per cent. This recommendation would have added only $254,000 to the mail pay of all the railroads in the United States.

Congress took no action on the recommendation, evidently considering the proposal too trivial for consideration, and preferring to await the recommendation of the joint congressional committee now investigating the whole subject.

In Great Britain the railways receive 55 per cent of the revenues from the parcel post. Before the establishment of the parcel post the railroads in this country received for transporting the mails at least one-fifth of the postoffice revenue. Assuming that their service is no greater in handling the parcel post than with other mail, this increased revenue of $60,000,000 to the postoffice department should in all fairness mean increased payments to the railroads of at least $12,000,000.

Nevertheless, the appropriation bill passed by congress provides no payment to the railroads beyond the provision already made, that 5 per cent might be added to the pay of railroads on which there had not been a weighing since January 1, 1913.

At a time when the Interstate Commerce Commission is insisting that the railroads shall make a fair charge for every service rendered it seems in the highest degree unjust that no provision should be made adequately to compensate the railroads for providing and operating the transportation machinery without which the mail service would be practically impossible.

INCREASED COST OF MAINTENANCE OF CARS AND LOCOMOTIVES.

At a hearing before the Interstate Commerce Commission, Mr. J. T. Wallis, general superintendent of motive power of the Pennsylvania Railroad Company, testified concerning the increased maintenance of equipment expenses incidental to the operation of the Pennsylvania Railroad System.

Mr. Wallis pointed out that the Pennsylvania System paid out $72,971,585 for maintenance of equipment in 1913 as compared with $58,197,036 in 1910—an increase of 25.39 per cent.

The Pennsylvania Railroad east of Pittsburgh had 4,242 locomotives on June 30, 1913, against 4,067 on June 30, 1910. Average tractive power in 1913 was 43,776 pounds against 31,013 pounds in 1910. Total locomotive miles were 128,334,119 in 1913 and 117,010,549 in 1910.

The cost of locomotive repairs on the Pennsylvania Railroad lines east of Pittsburgh for the year ended June 30, 1910, was $11,597,406. The cost of locomotive repairs for the year ended June 30, 1913, was $15,267,832, an increase of $3,670,426, or 31.7 per cent.

It cost proportionately more money to maintain a large locomotive than a small one, and the repairs of any given size locomotive will vary with the number of miles that the locomotive is run, namely, its use. It is accordingly proper to base comparison of the cost of locomotive repairs on tractive power miles, which are arrived at by multiplying the mileage of every locomotive in service by its tractive power.

Of the total increase of $3,670,426 in locomotive repairs, $1,129,940 is accounted for by increased rates of pay and by expenditures to meet changed conditions, and $1,843,988 as a result of increase in tractive power miles.

The cost of locomotive repairs today bears a proper relation to the class of locomotives that are being maintained when due consideration has been given to the general increases and various adjustments in wages that have been made since the adoption of locomotives of the type used today.

Repairs of freight cars cost the Pennsylvania System $24,121,049 in 1913 as compared with $18,281,364 in 1910. There were 268,364 cars the former year against 249,788 in 1910.

Of the total sum of $5,839,685 increased charges to repairs of freight cars, there is due to an increase in total freight car mileage $2,175,482. The increase in wages previously referred to in connection with locomotives caused an increase of $572,802. Expenditures rendered necessary by the standardization of equipment law accounted for a further sum of $1,190,054.

The remaining amount of $1,901,347 is due, first, to an increase in the price of yellow pine and oak used in repairs of wooden cars, and, second, to the increase in the capacity of the modern car.

REPAIRS COST MORE.

The character of the cars that are being constructed today is different from what it was ten years ago. Steel cars are coming in for heavy repairs, and the situation is gradually adjusting itself, but we will not have complete data as to the cost of repairs to such cars until a greater proportion of the steel cars have been passed through the shop for heavy repairs, and probably not until some of them, at least, have been discarded on account of decay, at which time an average figure for the reair of steel cars can be arrived at, but this is not possible today.

The cost of repairs to freight cars per million capacity ton miles has decreased each year as compared with the year 1903, this decrease for 1909 being 22.6 per cent. Since that time the decrease has not been so great, due to the fact that there was an increase in wages and added expenditure in connection with the standardization of equipment law. In the year 1913 there was a decrease of 17.4 per cent in the cost of repairs per million capacity ton miles under the cost of 1903. If the charges for the standardization of equipment law and the increase in wages were eliminated, the cost per million carrying capacity miles would have been .00069 as compared with .00093 in 1903, or a decrease of 25 per cent. In other words, it is quite plain that the cost of car repairs per unit of capacity available for loading is decreasing, if other varying factors, such as increases in wages and charges for standardization of equipment, are eliminated.

The cost of repairs to passenger equipment cars for the year ended June 30, 1910, was $2,681,753, and for the year ended June 30, 1913, $3,176,707, an increase of $494,954, or 18.4 per cent.

Of this, 6.6 per cent, or $176,006, is due to an increase in car mileage. An increase in wages heretofore referred to accounts for an additional amount of $75,781, or 2.8 per cent.

RENEWALS AND DEPRECIATION.

At the present time the Pennsylvania Railroad Company charges depreciation on the following bases: Locomotives and passenger cars on a basis of 4 per cent of the original cost of the equipment, and on freight cars on a basis of 3 per cent on such cost, for the reason that it is believed a locomotive will last about twenty years, and based on the final value of the scrap being 20 per cent of the original value, the depreciation plus the salvage will equal the original cost. On passenger cars it is believed that wooden cars will last twenty years. As far as steel cars are concerned, it is not known how long they will last, but in order to provide for the replacing of wooden with steel cars in a reasonable time, and for the steel cars when they shall have to be retired, the best figure the Pennsylvania has been able to arrive at is 4 per cent.

METALLIC PACKING.

By A. E. M.

In looking back over a good many years' experience in the metallic packing line, both as a manufacturer of metallic packing rings and as a user of them, the thought strikes me that if metallic packings were only given a fair show for their money, to use a slang expression, how much greater the mileage would be and how much fewer the complaints would be.

The writer has seen within the last twenty years many new metallic packings that were put on the market and a great many that were not, by far the greater number being of the latter. Some of the newer packings have much merit; others have not. The "have nots" are in the majority, but if the few good ones were used right how much easier the life of the packing man would be, and consequently the poor over-worked railway man would have less cause to complain.

This is the day of specialists. We have all kinds and breeds of specialists on railways, excepting packing specialists. The writer knows of only a few roads where the matter of metallic packings and their application is dignified by having a specialist attend to it. On these roads they have no packing troubles to speak of, not even on superheaters. Occasionally, of course, a packing will blow, but usually it's a case of being pretty well worn out and a set of new rings will cure the trouble; but how about the other roads, where anybody and everybody and usually nobody attends to packing matters. These are the kind of roads that give the packing man all his troubles and gray hairs. He is called in usually as a case of last resort and his packing is blamed for all their troubles. He scratches his head and tries to reason out why his packing works good over on the A. G. & W. S. and not here. Finally, when he lands in the roundhouse and calls for cases where his packing has apparently fallen down, he finds that a helper had applied the packing and a handy man had made the cups.

"The cups were new when applied and so, of course, they must be right," the roundhouse foreman argued.

"Well, let's see your cups, anyway, just so we can make sure," says the packing man.

When he tries his gauges in the cups he finds the angles off five or six degrees and the cups away too large in the piston fit and a few other things of a like nature. Of course the packing was to blame for this condition; that is, it was originally, but now what happens? The packing man gets the back-shop to make the cups right after a fixed standard and gauge, then he goes after the division master mechanic and gets his consent to have a regular machinist assigned to attend to all packing matters and see to it that a good one is selected for the job. After hanging around for a few days to observe that the new order of things is working out right, he leaves for new fields and does not get back on this road again for six months. When he does finally get back he finds that his packing is giving good satisfaction and everyone happy.

It is a matter of education, and if the numerous roads and officials would pay a little more attention to these matters of a like nature all would be clear sailing.

Purification of Water for Locomotives†

By P. M. La Bach, Assistant Engineer, C., R. I. & P. Ry.*

Scientific investigation tells us that pure water practically does not exist in nature. Snow and rain water in falling absorb the gaseos substances in the air. These are usually carbonic acid, nitric acid and ammonia. In addition to this, water is a weakly oxidizing agent itself. Some of the impurities, such as carbonic acid, aid in dissolving a number of substances which are found in ordinary soil. A further addition of carbonic acid to surface water on its way into the earth is made by absorbing decaying vegetable matter. Having acquired acid properties, the water readily absorbs various mineral substances which are found in ordinary soils, including salts of lime and magnesia. When once dissolved, these substances are colorless as a rule, and do not make their presence known. Custom has given the term "hardness" to the amount of salts in solution and we have "total hardness," "temporary hardness," etc., now used as technical terms. Table I shows the maximum amounts of different mineral substances which may be dissolved in pure water. These substances are found in varying quantities in nearly all water except that caught immediately upon falling.

TABLE I—SOLUBILITY IN 1 U. S. GALLON AT 60° F.

Calcium carbonate, $CoCO_3$	2.1 grains
Calcium chloride, $CaCl_2$	33.3 lbs.
Calcium sulphate, $CaSO_4$	134.1 grains
Magnesium carbonate, $MgCO_3$	Doubtful
Magnesium chloride, $MgCl_2$	16.6 lbs.
Magnesium sulphate, $MgSO_4$	2.5 lbs.
Sodium carbonate, Na_2CO_3	1.0 lb.
Sodium chloride, NaCl	2.9 lbs.
Sodium sulphate, Na_2SO_4	0.9 lb.

As the solutions in the table are for ordinary temperatures, it is apparent that when present in the earth of the neighborhood or in the rocks underneath the surface, that any supply of water taken from a well or running stream is apt to contain impurities in liberal quantities.

Rocks are worn away by the mechanical action of heat and freezing and are first oxidized, either by the oxygen of the air or by water. After this the hydrates of these substances are formed and solutions are made. In addition, there are a number of solutions of acids which may be either organic or inorganic in origin. These, in combination, form new substances which are soluble in water. The older chemists use the terms temporary and permanent hardness in referring to these compounds. Temporary hardness was understood to be the difference between the total hardness and permanent hardness, while permanent hardness was that portion not precipitated by boiling. The effect of boiling is to drive off the carbon dioxide and precipitate the carbonates. In a great many of the reports, however, only the total hardness is given. The different units and their method of calculation properly belong to unabridged editions of books on this subject, but for reference the standard units are found in Table II.

TABLE II—STANDARDS OF HARDNESS.

German: One degree of hardness is the solution of one (1) part calcium oxide (CaO) in 100,000 parts of water, or .01 gram in one litre.

French: One degree of hardness is the solution of one (1) part calcium carbonate ($CaCO_3$) in 100,000 parts of water, or .01 gram in one litre.

English: One grain of calcium carbonate per "Imperial" gallon of 70,000 grains.

American: One grain of calcium carbonate per "U. S." gallon of 58,381 grains.

The American and English standards are in the same unit as the French, $CaCO_3$, and in the proportion 58,381:70,000:100,000. One degree of French standard for hardness equals 1.79 degrees of the German.

There are innumerable substances found in water polluted by sewage and mill-waste, but each forms a separate problem and no general rules can be applied.

The impurities found in water may be classified thus:

I. Suspended matter: — Removed by Mechanical Filtration.
- (a) Organic matter,
  - 1. Animal matter,
  - 2. Vegetable matter,
  - 3. Micro-organisms,
  - 4. Algae.
- (b) Inorganic matter:
  - 1. Mineral matter,
  - 2. Mineral oils,
  - 3. Clay,
  - 4. Sand,
  - 5. Silt.

II. Dissolved substances: — Removed by heating or precipitated by chemical reagents.
- (a) Gases
  - (1) Oxygen,
  - (2) Carbon dioxide,
  - (3) Chlorine,
  - (4) Hydrogen sulphide,
  - (5) Ammonia,
- (b) Solids
  - (1) Organic,
  - (2) Inorganic.

Professor Edward B. Warman gives the following interesting classification:

"Raw water is an aquarium.
Boiled water is a grave-yard.
Mineral water is premature old age.
Filtered water is a gay deceiver.
Distilled water is purity."

Boiler waters are usually divided into four classes when reference is made to the soluble impurities which cause trouble when in solution, these impurities being (1) Incrusting solids, (2) Inert substances, (3) Corrosion substances, (4) Substances causing priming and foaming.

Incrusting solids are those which form a coating or scale in the interior of the boiler through the action of either the heat or pressure. They are usually of two kinds, those forming hard scale or those forming soft scale.

Inert substances are those which are harmless and have no action on the boiler. Their only effect is to raise the temperature of the boiling point. (3) and (4) are usually called non incrusting substances. They are defined as follows:

A corrosive substance is one which causes deterioration of the steel of the boiler either by chemical or electrolytic action.

"A boiler is said to prime when water is carried as steam-bubbles, with the steam up through the water to its surface, and may be considered as affecting the entire depth of the water in a boiler."

Foaming is the result of suspended impurities in the water, which rise to its surface in a more or less dirty condition and form a scum. Pure water cannot produce foam; steam from a boiler which foams is dryer than that from a boiler which primes."

INORGANIC IMPURITIES FOUND IN WATER.

Calcium Bicarbonate, $Ca(HCO_3)_2$, is in practically every natural water. In nature the carbonate of lime is usually in the form of limestone, marble or chalk which are only slightly soluble in pure water. Water containing carbonic acid gas or carbon dioxide, CO_2, readily dissolves them and forms the bicarbonate. When

*Member American Society of Civil Engineers and Member American Railway Engineering Association.

subjected to a temperature of about 200 degrees F. much of the CO_2 is driven off and the carbonate precipitated. The same action is produced by chemical reagents as shown in Table III. This substance forms soft scale or mud in a boiler, unless in combination with other substances, when it may form a very tough and resistant scale.

Magnesium Bicarbonate, $Mg(HCO_3)_2$, is more soluble in water than the calcium bicarbonate. It is formed from the carbonate in a manner similar to that of the calcium bicarbonate. Magnesium carbonate is a well known toilet preparation. Also it is used as a covering for steam and other pipes on account of its being a good non-conductor of heat. When heated, it breaks up into magnesium hydrate, magnesium oxide and carbon dioxide. It also has a tendency to cause foaming. It is precipitated by the different reagents found in Table III.

Calcium Sulphate, $CaSO_4$, is generally known as gypsum, alabaster or plaster of Paris. It is responsible for the formation of the hardest kind of scale. It is more soluble at low than at high temperatures and pressures and when the pressure in a boiler passes above 50 lbs. it begins to precipitate. Practically all of it precipitates at 300 degrees F. It is a poor conductor of heat and adheres to the shells and tubes of boilers.

Magnesium Sulphate, $MgSO_4$, is commonly called epsom salts. It is readily soluble in both warm and cold water and does not of itself form scale in boilers. It belongs to the third division given above as it has marked corrosive action. In the presence of lime it forms a scale as $Mg(OH)_2$. This action is shown in Table III.

Calcium Chloride, $CaCl_2$, is very soluble in water and corrosive in its action. It does not form scale under ordinary circumstances. However, when heated with magnesium sulphate, a transfer of acids takes place and calcium sulphate and magnesium chloride are formed. The first forms a hard scale while the latter is corrosive.

Magnesium Chloride, $MgCl_2$, is the destructive corrosive compound found in sea water. It is very soluble and pits or grooves the interior of the boiler. It is generally supposed to break up under heat and pressure, releasing the chlorine which forms hydrochloric acid.

Sodium Chloride, NaCl, is common salt. It is easily soluble and causes priming, but is non corrosive. It must be removed from the boiler by blowing off, since when present in large quantities it causes priming. The nitrates of sodium, calcium and magnesium are seldom found in appreciable quantities in water. Oxides of iron and aluminum as well as silica are usually considered to be present in a colloidal state. These substances ordinarily occur in very small quantities.

Iron and Aluminum Sulphates, $Fe(SO_4)_3$ and $Al_2(SO_4)_3$, are known by their trade names, copperas and alum. Their action is similar to sulphuric acid.

Bicarbonate of Iron, $Fe(HCO_3)_2$, forms a hard scale when heated and reduced to the carbonate.

Alumina, Al_2O_3, is soluble in water and does not form scale unless acids are present.

Oxide of Iron, Fe_2O_3, is insoluble in water.

Sulphuric Acid, H_2SO_4, is seldom found except around mines and sulphur deposits. With the steel of the boiler it forms $FeSO_4$, resulting in continuous pitting action.

Hydrogen Sulphide, H_2S, is seldom found and readily breaks up into its two elements.

Sodium Carbonate (Na_2CO_3) causes priming and incidentally foaming when present in excessively large quantities. The latter action is caused by disintegrating other "scale forming" matter usually present with sodium carbonate. Sodium bi-carbonate usually accompanies the normal carbonate. The heat of the boiler will break up both of these carbonates, although, of course, the bi-carbonate is the less stable. The carbon dioxide (CO_2) thus driven off gives rise to corrosion above the water line, and is especially destructive in steam lines of stationary power plants. See Table III for chemical treatment. Sodium carbonate, in the form of soda ash, is generally used for the removal of "permanent hardness," such as sulphates and chlorides.

From the viewpoint of the boiler, the two most important things to be considered in connection with the use of water are corrosion and scale. Pure distilled water corrodes a boiler as badly as some impurities.

A good deal of mystery used to surround the question of corrosion. The numerous schemes to prevent it were only partially successful as they were founded on hit and miss methods. The older idea of oxidation has given place in the last few years to the electrolitic theory. Electric current passes from the higher potential to the lower when two different elements come in contact. The effect depends of course upon the substance. The following, taken from a series of tests made under government supervision, is the latest authoritative statement on the subject.*

"From practical experience, study and much experimental work, the writer's conception of corrosion is as follows:

1. All metals dissolve in water or in water solutions if the electric potential of the metal at any point is higher than that of the water or solution.

2. Corrosive products or rust result from the oxidation of the dissolved particles of metal held in solution.

3. The solution pressure of a metal in any liquid is the increase in electrical potential of the metal over that of the liquid.

4. If the potential of the metal in contact with water is higher all over its surface than that of the water, it will corrode evenly or nearly so. If the potential of only one point in the surface of the metal is higher than that of the water, it will pit or corrode locally at that spot. Metals do not pit or groove noticeably in distilled water, acid solutions, or when in contact with a metal of lower electrical potential in water.

5. Local corrosion on bare iron or steel only takes place in water the potential of which has been raised until it is higher than that of certain areas of the metal.

6. Oxygen and carbonic acid do not cause corrosion. If the metal can dissolve they do increase its rate by removing the particles of it from the liquid and thereby preventing an increase in the potential of the liquid.

7. When iron is placed in perfectly pure water into which no oxygen can dissolve, the iron first tends to dissolve, due to its higher potential. Each particle of iron dissolved raises the potential of the water and exposes a new particle of iron. Eventually the potential of the water will be equal to that of the metal at every point, dissolving will stop, and the solution will be saturated. Now if oxygen is present in the water, as the iron is dissolved it will be oxidized, and the potential of the liquid will be raised only to the point where there is equilibrium between the rate of solution of the iron and that of the oxygen, and corrosion of the iron will continue.

8. Metals corrode in sea water at a greater rate than in distilled water due to the higher conductivity of the former. The metal particles get away from the metal and in contact with oxygen or CO_2 more freely and the potential of the water is kept from rising. The natural potential of sea water is not raised to any appreciable extent by the metallic salts it contains, because the high potential metals of these salts are mostly combined with strong acid radicals such as chlorides and sulphates.

9. Hydrogen and all elements lower in the electromotive series than hydrogen, decrease the potential of water in which they are in solution. All elements electropositive to hydrogen increase the potential of the water when they are in solution.

10. The alkalies are the highest in the electromotive series, and are therefore the most soluble in water. They raise the potential of water in which they are in solution.

11. The sodium salts of weak acids increase the potential of water at a greater rate than do the same salts of strong acids.

12. The potential of a solution containing a metal higher in the electromotive series than another metal immersed in it, will

* "The Corrosion of Boilers and Piping on Shipboard," by Commander Frank Lyon, U. S. N. Journal of American Society of Naval Engineers. 1912.

LIME AS A REAGENT

Calcium Bi-Carbonate	+	Lime	=	Calcium Carbonate	+	Water		
$Ca(HCO_3)_2$	+	$Ca(OH)_2$	=	$2\ Ca\ CO_3$	+	$2\ H_2O$		
162	+	74	=	200	+	36		
Soluble		* Soluble		Insoluble				

Magnesium Bi-Carbonate	+	Lime	=	Mg Hydrate	+	Calcium Carbonate	+	Water
$Mg.(HCO_3)_2$	+	$Ca(OH)_2$	=	$Mg(OH)_2$	+	$2\ Ca.CO_3$	+	$2H_2O$
146.4	+	148	=	58.4	+	200	+	36
Soluble		* Soluble		insoluble		Insoluble		

Carbonic Acid	+	Lime	=	Calcium Carbonate	+	Water
H_2CO_3	+	$Ca(OH)_2$	=	$Ca.\ CO_3$	+	$2\ H_2O$
62	+	74	=	100	+	36
Soluble		Soluble		Insoluble		

Sulphuric Acid	+	Lime	=	Calcium Sulphate	+	Water
H_2SO_4	+	$Ca(OH)_2$	=	$Ca\ SO_4$	+	$2\ H_2O$
98	+	74	=	136	+	36
Soluble		* Soluble		Soluble (Cold)		

Bi-Carbonate of Iron	+	Lime	=	Calcium Carb.	+	Iron Hydrate	+	Water
$Fe(HCO_3)_2$	+	$2Ca(OH)_2$	=	$2\ Ca\ CO_3$	+	$Fe(OH)_2$	+	$2\ H_2O$
178	+	148	=	200	+	90	+	36
Soluble		* Soluble		Insoluble		Insoluble		

Hydrogen Sulphide	+	Lime	=	Calcium Sulphide	+	Water
H_2S	+	$Ca(OH)_2$	=	$Ca.S$	+	$2\ H_2O$
34		74		72		36
Soluble		Soluble		Slightly Soluble		

Soduim Carbonate	+	Lime	=	Calcium Carbonate	+	Soduim Hydrate
Na_2CO_3	+	$Ca(OH)_2$	=	$Ca\ CO_3$	+	$2\ Na\ OH$
106		74		100		80
Soluble		Soluble		Insoluble		Soluble

Caustic Soda	+	Calcium Bi-Carbonate†	=	Sodium Carbonate	+	Calcium Carbonate	+	Water
$2\ Na\ OH$	+	$Ca.(HCO_3)_2$	=	$Na_2\ CO_3$	+	$Ca\ CO_3$	+	$2H_2O$
80		162		106		100		36
Soluble		Soluble		Soluble		Insoluble		

* Lime is only partially soluble. The lower the temperature the greater the solubility. † Magnesium Carbonate, $Mg.\ CO_3$ gives a similar reaction

SODA ASH AS A REAGENT

Sulphate of Lime	+	Soda Ash	=	Calcium Carbonate	+	Sodium Sulphate
$Ca\ SO_4$	+	$Na_2\ CO_3$	=	$Ca\ CO_3$	+	$Na_2\ SO_4$
136	+	106		100		142
Soluble		Soluble		Insoluble		Soluble

Mg. Sulphate	+	Soda Ash	+	Lime	=	Mg. Hydrate	+	Sodium Sulphate	+	Cal. Carbonate
$Mg\ SO_4$	+	$Na_2\ CO_3$	+	$Ca(OH)_2$	=	$Mg.(OH)_2$	+	$Na_2\ SO_4$	+	$Ca\ CO_3$
120.4	+	106	+	74	=	58.4	+	142	+	100
Soluble		Soluble		Soluble		Insoluble		Soluble		Insoluble

SODA ASH AS A REAGENT (Continued)

Chloride of Lime	+	Soda Ash	=	Calcium Carbonate	+	Sodium Chloride
$Ca\ Cl_2$	+	$Na_2\ CO_3$	=	$Ca\ CO_3$	+	$2\ Na\ Cl$
111	+	106	=	100	+	117
Soluble		Soluble		Insoluble		Soluble

(Heating Aids in Above)

Chloride of Mg.	+	Soda Ash	+	Lime	=	Mg. Hydrate	+	Sodium Chloride	+	Cal. Carbonate
$Mg\ Cl_2$	+	$Na_2\ CO_3$	+	$Ca(OH)_2$	=	$Mg(OH)_2$	+	$2\ Na\ Cl$	+	$Ca\ CO_3$
95.4	+	106	+	74	=	58.4	+	117	+	100
Soluble		Soluble		Soluble		Insoluble		Soluble		Insoluble

Nitrate of Lime	+	Soda Ash	=	Calcium Carbonate	+	Sodium Nitrate
$Ca(NO_3)_2$	+	Na_2CO_3	=	$Ca\ CO_3$	+	$2\ Na\ NO_3$
163.86	+	106	=	100	+	169.86
Soluble		Soluble		Insoluble		Soluble

BARIUM HYDRATE AS A REAGENT

Calcium Sulphate	+	Barium Hydrate	=	Calcium Hydrate	+	Barium Sulphate
$Ca\ SO_4$	+	$Ba(OH)_2$	=	$Ca(OH)_2$	+	$Ba\ SO_4$
136	+	171	=	74	+	233
Soluble		Soluble		Slightly Soluble		Insoluble

Magnesium Sulphate	+	Barium Hydrate	=	Magnesium Hydrate	+	Barium Sulphate
$Mg\ SO_4$	+	$Ba(OH)_2$	=	$Mg.(OH)_2$	+	$Ba\ SO_4$
120.4	+	171	=	58.4	+	233
Soluble		Soluble		Insoluble		Insoluble

SILICATE OF SODA AS A REAGENT

Silicate of Soda	+	Calcium Bi-Carb.	=	Sil. of Cal.	+	Sodium Carb.	+	Carb. Diox.	+	Water
$Si\ O_3\ Na_2$	+	$Ca\ H_2(CO_3)_2$	=	$Ca\ Si\ O_3$	+	$Na_2\ CO_3$	+	CO_2	+	H_2O
122.2	+	162	=	116.2	+	106	+	44	+	18
Soluble		Soluble		Insoluble		Soluble		Soluble		

Silicate of Soda	+	Calcium Sulphate	=	Sodium Sulphate	+	Calcium Silicate
$Si\ O_3\ Na_2$	+	$Ca\ SO_4$	=	$Na_2\ SO_4$	+	$Si\ O_3\ Ca$
122.2	+	136	=	142	+	116.2
Soluble		Soluble		Soluble		Insoluble

MAGNESIA AS A REAGENT

Calcium Bi-Carbonate	+	Mag. Hydrate	=	Calcium Carbonate	+	Mg. Carb	+	Water
$Ca\ H_2(CO_3)_2$	+	$Mg.(OH)_2$	=	$Ca\ CO_3$	+	$Mg\ CO_3$	+	$2H_2O$
162	+	58.4	=	100	+	84.4	+	36
Soluble		Insoluble		Insoluble		Insoluble		

Mag Bi-Carbonate	+	Mag. Hydrate	=	Magnesium Carbonate	+	Water
$Mg.(HCO_3)_2$	+	$Mg(OH)_2$	=	$2\ Mg\ CO_3$	+	$2\ H_2O$
146.4	+	58.4	=	168.8	+	36
Soluble		Insoluble		Insoluble		

BARIUM CARBONATE AS A REAGENT

Calcium Sulphate‡	+	Barium Carbonate	=	Barium Sulphate	+	Calcium Carbonate
$Ca\ SO_4$	+	$Ba\ CO_3$	=	$Ba\ SO_4$	+	$Ca\ CO_3$
136		197		233		100
Soluble		Soluble		Insoluble		Insoluble

‡ Magnesium Sulphate, $Mg.\ SO_4$, gives a similar reaction

Table III. Action of Various Reagents on Dissolved Substances.

increase faster with a rise in temperature than that of the immersed metal.

13. When boiler water is properly treated, air, copper, graphite, zinc oxide and other electronegative metals in contact with iron or steel have no effect whatsoever in starting and maintaining corrosion, but they do have a very serious effect if the water is not properly treated, and their effect increases with the perfection of their metallic contact with the metal of the boiler.

These tests also showed a fact that is contrary to the popular ideas of the subject. 'No concentration that has been found to be non corrosive to iron or steel at room temperatures has ever been found corrosive at temperatures up to 420° F., that corresponding to a steam pressure of 300 pounds gage. It has been found that concentrations just below the upper limit, and therefore corrosive, were non corrosive to the same steel at higher temperatures. It must be that with rise in temperature the potential of the solution rises faster than that of the metal.'

The conclusion of the whole matter is as follows: 'The writer has no hesitancy in saying that *any boiler using any water can be kept from corroding for any length of time, if treated with soda and if its concentration is maintained at or above 3 percent. normal alkaline strength. If the water is not to be kept sufficiently alkaline, it had better be kept neutral.*' "

The above method has been extensively used and is now standard practice on the ships of the Navy, but has apparently not been tried to any extent on shore. The lime and soda ash treatment has frequently accomplished the same result, incidentally, due to furnishing a slight excess beyond the theoretical requirements of reagents necessary to effect a proper reduction in the hardness.

Books on boiler operation give analyses of a great variety of boiler scales. In the foregoing the chemicals which may be found in scale have been given. The division of scale into hard and soft is practically as good as any other. The scale ordinarily found may be divided roughly into these two classes.

Scale increases the cost of boiler operation in several ways, by (1) Insulating the tubes and sheets so that part of the heat is not transmitted to the water; (2) Causing overheating of tubes and sheets. The crown sheet usually suffers the most from this cause; the sheet being in direct contact with the flames, the temperature rises to the point at which the scale will transmit the heat to the water; (3) Causing boiler explosions; there are cases in which the scale has cracked suddenly, allowing the water to come in contact with the super-heated plate, causing the generation of a large amount of steam and exploding the boiler; (4) Causing shut-downs for cleaning or repairs; (5) Causing loss of heat and water through blowing-down to remove soft mud.

The expense of removing boiler scale by mechanical means is frequently very great, as some of the worst places for scale to accumulate are not readily reached. The use of water treated with lime and soda ash in an ordinary softener, will cause a great deal of scale to detach itself. It can then be readily removed.

Treating water, in order to precipitate the deleterious substances found in solution, usually is attempted by one of two methods. The treatment may be done, after a fashion, in the boiler by the use of boiler compounds. The better method is to treat the water before it goes into the boiler.

There are a great many boiler compounds now on the market and new ones appear now and then. After listening to the salesmen handling them one wonders that anybody ever had any trouble with water. One agent makes the claim that his compound changes the shape of the molecule from the hook-shaped to the spherical. The spherical being round cannot stick to a plane surface and form scale. Another tells a wierd tale of how the substance, when it comes in contact with hot metal expands and rebounds. Apparently it is expected to bounce around like a rubber balloon. The literature on the subject is very scarce and the following is largely taken from a government report on the subject.*

* "Boiler Compounds"—Commander Frank Lyon, U. S. N. Journal American Soc. Naval Engineers, 1912.

"The perfect boiler compound must fulfill the following requirements: (a) It must render the water in the boiler non corrosive at any temperature to which it may be subjected; (b) It must hold in suspension, or preserve in the colloidal form, all of the salts in the water that would otherwise be precipitated as a scale, whether such precipitation be by the action of heat or by that of any of the chemicals used in the compound; (c) It must render the treated water no more liable to foam or prime than distilled water under the same conditions; (d) It must be composed of chemicals that are safe to store, that do not deteriorate materially with age, and that are non-explosive and non-inflammable; in other words, the compound must be such that it requires no particular care in stowing or handling; (e) Some one constituent must be such that its strength in the water (its concentration) can be easily measured by some simple chemical measuring device."

The following tests should be made to form an idea of the merits of the compound: (A) Chemical; (B) Corrosion; (C) Scale removal; (D) Priming.

A test of this nature will take time but when once made the substance can be handled intelligently by any one capable of taking care of a boiler. When contemplating the use of a compound, the man in charge of a boiler must first understand the nature of the treatment, the results to be obtained, and the work of the fireman in connection therewith.

Examination of the records in the Patent office show that there are compounds guaranteed to remove boiler scale of which hydrochloric acid is the base. It will remove the scale and boiler also in time. In fact the more scale there is the safer the process. Graphite is frequently used also. It removes scale for the same reason that hydrochloric acid does. It corrodes the boiler underneath the scale and aids in its removal by forming "rust."

The treatment of the feed water before it goes into the heater or boiler is the most satisfactory process. It attracted the attention of chemists three-quarters of a century ago, and in 1841 Dr. Clark of Aberdeen, Scotland, found that the carbonates usually present in well or surface water would be precipitated by the addition of hydrate of lime. Later Dr. Porter discovered that the sulphate of calcium, which is probably the most serious scale forming substance commonly found, could be precipitated by the addition of caustic soda or soda ash. Since their time, these substances have been used as reagents principally on account of their cheapness. There are other efficacious methods but they cannot compete in cost. The early softeners were simply large tanks in which the reagent was placed with the water to be treated. The mixture was stirred by mechanical means and allowed to stand until the water was clear. This is practically what we now call the intermittent process, although air is used as a mechanical mixer, to stir the solution. Some chemists prefer the intermittent type as they claim they get a more uniform mixture and know exactly what proportion the chemicals bear to the impurities in the raw water. Where the treating tubs can be placed at an elevation so that the water will not require repumping, but flows direct to the storage tank or point of use, it has some advantages.

Inventors at an early date undertook to make the mixture as the water was pumped into the softener. This type has been called the "continuous." One of the earliest perfected was the Stingl in Germany. The subject of the continuous softener began to attract attention in America about the beginning of the present century and the industry has made great strides since that time.

The continuous type has been preferred both in Europe and America on account of its being a "going concern."

The modern type usually consists of a softening or reaction chamber and a settling tank wherein the soft water deposits the hardness which has been precipitated in the softening chamber. The purified water is then discharged into a storage tank. The sludge is ordinarily removed to a convenient sewer or sump by opening valves located in the bottom of the settling tank.

The diagram, Figure 1, shows all the essential features of a continuous plant. Chemical solutions are prepared at the foot of softener, pumped to the top and proportioned by weirs and deliv-

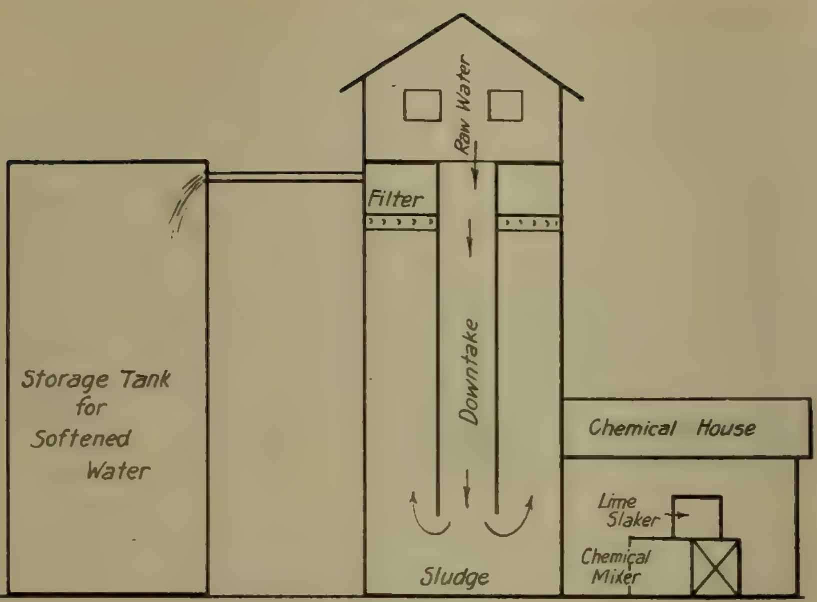


Fig. 1.

ered at top of downtake with the raw water. In others the proportioning is done by weirs at the bottom in the chemical house. Some have agitators in the downtake and some do not. Filters are in practically all, except a new type recently installed. Notwithstanding the apparent simplicity of the problem, there are a large number of builders of these machines. The proportioning devices are usually patented and constitute the principal difference. In the United States there are a number of well known makes. In Europe the first continuous softener placed in commission was known as the Beranger and Stingl. It was built in 1874. Stingl is usually credited by continental chemists with having been the inventor of the soda ash process. A few of the other well known makes are: Deeley, Criton, Guttman, Desrumeaux, Wehrenfennig, Reisert, Brunn-Loewener, etc., etc.*

The aim in the majority of these machines is to have the flow of water proportion and mix the chemicals and furnish the power for the chemical tank agitator. The mixing of the raw water and reagents is usually accomplished by numerous baffle plates. These machines work very well in the hands of skilled attendants, but must be run with great exactness and care.

In the multiplicity of details, one is apt to lose sight of the fundamental principles involved. The best type of machine in the opinion of the writer (there are several makes) should have the following characteristics:

(1) Power should be furnished by an overshot wheel on top of softener. It is positive in action, its speed is proportional to the flow and it will not have difficulty in handling water containing grit, etc.

(2) The chemical tanks for reagent should be on the ground. They should be of ample size in order that the solution (particularly of lime) will not be too strong. A concentrated mixture will require excessive mixing and cause trouble with chemical pumps.

(3) The proportioning should be done by weir measurement, trip bucket or weighing device.

(4) The chemicals should be introduced at the top of the downtake and not under pressure at the bottom.

There should be thorough mechanical mixing of the chemicals and raw water in the downtake in order to hasten the precipitation. In some of the schemes the flow of the water and the consequent intermingling is relied on to do this.

Wehrenfennig gives the following tabulation on the progress of softening:

Period of clarification in hours	—1— H.	—1— A.	—2— H.	—2— A.	—3— H.	—3— A.	—6— H.	—6— A.	—10— H.	—10— A.
Addition of reagents according to calculation.	12.0°	4.2	9.3°	3.4	6.7°	2.7	6.5°	2.7	6.5°	2.65
	22.5°	6.5	12.8°	4.5	10.7°	4.1	8.9°	3.3	8.5°	3.0

H—Hardness in German degrees.
A—Alkalinity.

It will be seen that it takes ten hours for part of the scale forming chemicals to precipitate. By the mechanical mixing of the water in the downtake the chemical reactions and settling are hastened. This seems to be on the principle of the snow ball. These particles adhere when brought in contact and form large flakes which settle rapidly. The following experiment shows this very clearly. (See Figure 2 and Figure 3.)

* "L'eau dans l'industrie," par H. de la Coux.
"Über das Untersuchung und das Weismachen des Kesselspeiswassers," von E. Wehrenfennig.

The water selected for the experiment contained a hardness of 16.6 and alkalinity of 13.7 both in grains per U. S. gallon. The chemicals added were identical in each case. The reagents used were 90% lime equivalent to 1.9 pounds per 1,000 gallons, and 58% soda ash equivalent to 1.2 pounds per 1,000 gallons.

The photograph, Figure 2, was taken three minutes after the chemicals had been added. In the unstirred experiment (2b) the chemicals were mixed with the water by eight revolutions of the agitator. The stirred sample (2a) was subjected to agitation by the agitator at 24 or 25 revolutions per minute, corresponding to about 10 feet per minute for the three minute period.

Figure 3 was taken 6 minutes after the experiment was begun. The agitation of the sample (a) had ceased just prior to taking

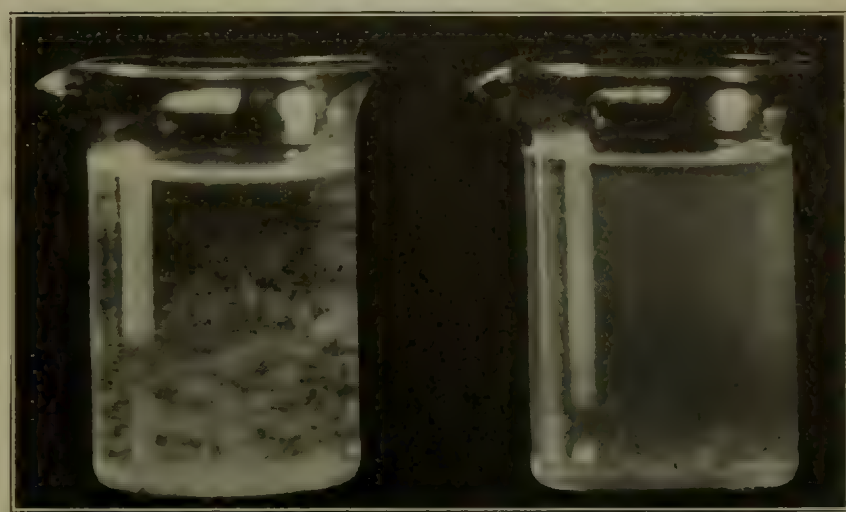


Fig. 2a Fig. 2b
Showing Difference in Settlement of Sludge at the End of Three Minutes.

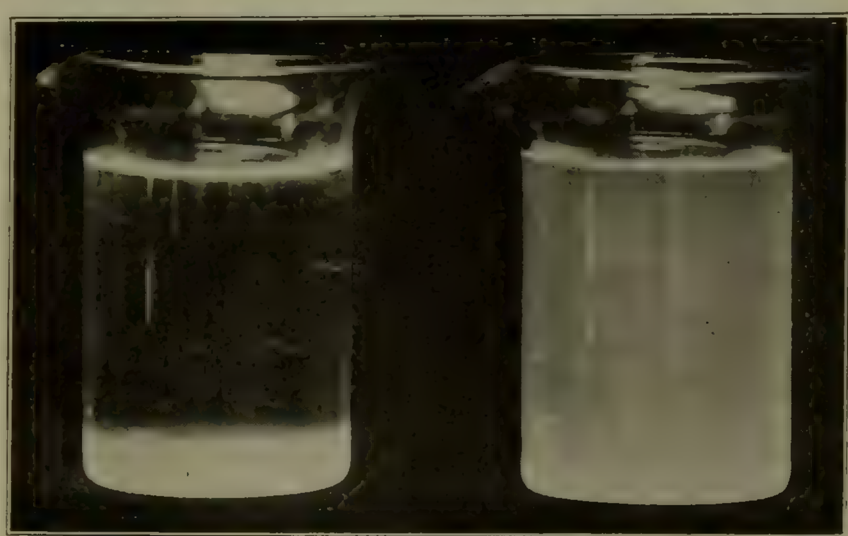


Fig. 3a Fig. 3b
Showing Difference in Settlement of Sludge After Six Minutes.

(2a) so that (3a) represents the result of three minutes' agitation plus three minutes' quiescent subsidence.

The latter picture shows that practically no sedimentation had taken place in (3b) which was not sufficiently agitated, while in (3a) the precipitate had practically settled out.

This question of the rapidity of reaction and settling has a very important bearing upon the proportioning of water-softeners for railroads. Generally, there is a storage tank in the ground before a softener is proposed. This tank is frequently over 60 feet in height. The softener will have to be higher than the storage tank, say 66 feet for example. Then the start is made with the statement that the softener shall have 6 hours capacity. In the above case this would mean that the rate of upflow would be over 10 feet per hour. With ordinary waters the rate of sedimentation (particularly when water contains magnesia) will be less than the rate of upflow and the sludge will be carried upward and must be removed by a filter. This filter must be frequently cleaned and will not remove all the precipitate at the best. When this is true, secondary sedimentation will take place in the storage tank and frequently milky water passes over into the tender. The cost of removing an old high tank and putting at a new site should be

considered in connection with a softener which is low and broad. Figures 4 and 5 show a softener erected by the L. M. Booth Co., for the Rock Island Lines at Burr Oak, Ill., in which the rate of upflow has been reduced to a minimum. This softener has a capacity of 50,000 gallons per hour and supplies a round house, switch and road engines. At the beginning of work in the morning and at noon the draft is very heavy and large storage capacity is required. The standpipe at the right of the picture carries a head of 80 feet. The softener provides a storage capacity of 308,000 gallons of softened water. There is an overshot wheel which provides power for the agitator in the downtake and for the pump and agitator in the chemical house at the foot of the tank.

Fig. 4. Burr Oak Combination Softener and Storage Plant.

The purifying chemicals, lime and soda, are prepared in the chemical house. The regulator which proportions the flow of chemicals is also at ground level.

The reagents which have been used at different places are shown in Table III. Lime and soda ash being the cheapest are the ones oftenest used. But soda ash leaves soluble salts in the solution which cause foaming if present in large quantities. The amount of foaming salts that a locomotive boiler can take care of without trouble varies from 100 to 200 grains per gallon. The question of whether foaming will take place or not depends upon the shape of the boiler and the amount of matter in suspension.

If all the water stations on an engine district furnish softened water, the water may be more completely treated; that is, softened to a lower degree, than if the locomotives take a portion of their supply from raw water sources. A completely softened water, one in which sufficient soda has been used to reduce the hardness to the minimum, has a tendency to disintegrate scale deposited from hard water. This finely divided old scale is responsible for the foaming which occurs shortly after the introduction of softened water to boilers which were not free from sediment.

Torpedo boats and similar crafts have boilers which can use sea water without trouble. The locomotive boiler is jarred and shaken to such an extent that it is one of the worst subjects possible in this respect. The salts of barium would be very useful in water softening but as they are poisonous the trainmen might be affected by them, as they drink a good deal of the water. The barium and silica compounds are produced in the electric furnace and will probably be cheaper in the future than at present.

In Table III, the molecular weights of the different chemicals are given for convenience in computation. A solution containing 162 grains of calcium bicarbonate by the addition of 74 grains of lime would have as a precipitate 200 grains of calcium carbonate and water. These refer to pure chemicals. When bought commercially the basis should be the net weight of pure chemicals and not the gross weight.

In computations the amount of scale removed, in pounds, is frequently used as a unit. It is generally safe to assume that the grains per gallon of incrustants will be reduced to 5. If you have a 26 grain water, by analysis, 21 grains will be removed. The number of grains removed per gallon divided by 7 will give the number of pounds per 1,000 gals.

21/7 = 3 lbs. incrusting matter removed.

or 21 × 1,000 = 21,000 grains removed.

21,000 ÷ 7,000 (grains per pound) = 3.

Whether or not it pays to soften water on a railroad has been debated in a good many ways. As a general proposition there can be no doubt of it, but just where the dividing line between waters that will justify treatment and those which will not, is not so certain. It depends upon the amount of water used rather than upon

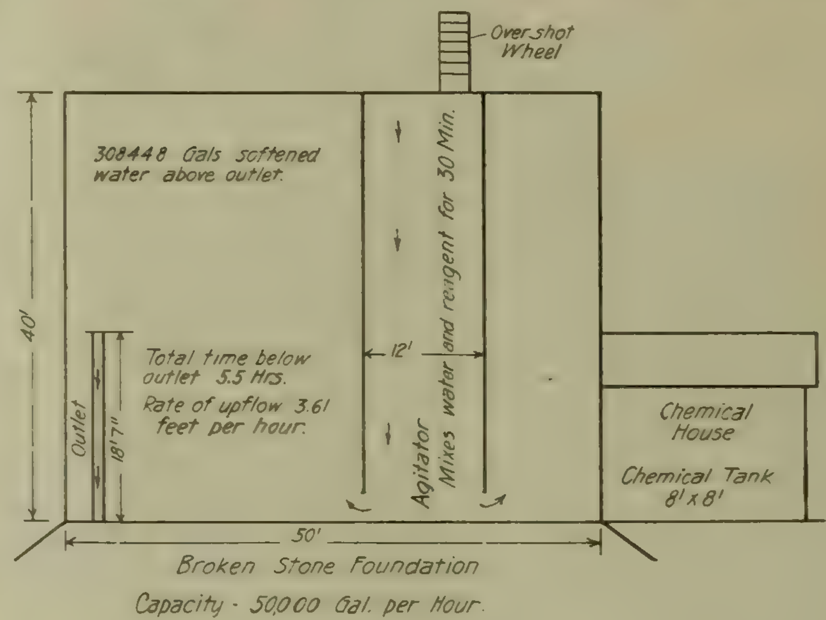


Fig. 5.

the hardness of any particular water. With water containing calcium sulphate in such amount that it produces foaming when treated, it might not pay if only one point on an engine district is equipped with a softener, while the reverse would be true if all points were affected. To get the full benefit, each point on a district should have softened water. Railroads do not keep the costs of boiler repairs in such a fashion that the amount of money expended due to impure water can be segregated.

A method of computing the value of a softening plant is briefly as follows:

Z = number of pounds incrusting solids, in thousands, removed per annum.

A = additional cost of water service in units of 1,000 lbs. of solids removed, (1) wages, (2) repairs, (3) chemicals, (4) additional power at water station, (5) light, heat, etc., (6) cost of water and heat lost when treated water required blowing out.

B = money saved by the removal of 1,000 lbs. of solids; (1) boiler washing, (2) repairs, (3) fuel, (4) increased locomotive performance. Additional miles service which would be had if locomotive is not in shop undergoing repairs to boiler.

I = interest per annum on softening plant.

C = cost of said plant.

L = estimated life of plant.

S = salvage at end of that period.

D = depreciation per year. That is, a sum per year which, if placed in a sinking fund at I rate of interest, will equal C — S in L years.

Savings and outlay would balance when

$$A\ Z = B\ Z + I + D.$$

The number of pounds, in thousands, which must be removed each day in order that the savings and cost will just balance will be:

$$\frac{I + D}{0.365\ (A - B)}$$

The mechanical department of each railway should be able to furnish the data for A, when the quality of the water is given.

IMPROPER LOADING OF BOX CARS.*

By W. H. Sitterly, General Car Inspector, Pennsylvania R. R.

Several branches of the railroad service are directly interested in the matter of improper loading of box cars. First, the agent of the railroad, who can assist if he will endeavor to have loaded only at his warehouse and teaming tracks such cars as are fit for loading. A strict observance of the inspector's shop marks on the car by his subordinates will be the means of the defective car moving to the shop repair track instead of receiving a load and then moving to the shop for repairs before it is placed in a train, thereby reducing the revenue that the company should receive for transporting the commodity to its destination. Proper stowing of some commodities in the car by the agents' forces will prevent it coming in contact with the doors en route and will not require doorway protection.

I believe that every one present here tonight can recite cases where cars have been loaded at the freight station and teaming siding to be delivered to a connecting line, the line making the switching movement receiving but $3.00 for such movement and paying to the receiving line from $4.00 to $20.00 for a transfer or readjustment of the lading. Instead of the line which made the switching movement receiving a profit from such haul, they were assessed a large amount of money above the switching charge. This also applies to a load where the destination is on the line where the car was loaded. Instead of being placed in the first train and moving to destination, it makes a shop track movement; a large amount of money is placed on it due to defects, thereby reducing the amount of revenue that should have been enjoyed by the railroad for hauling the commodity to destination.

There is another feature to be taken into consideration besides the money lost for the immediate case, and that is a dissatisfied shipper. Promise has been made to him or he expects the commodity to reach his customer at a certain date and it does not, for the reason that the car makes a shop track movement with the load and is delayed in transit from 24 to 48 hours, and in some instances longer. This is bad in a competitive district.

I have found in a great many instances where I have investigated cases of delays and claims for damage that cars bearing inspector's shop marks have been moved from the distributing point to the loading point and loaded. At the time of collecting the cars for distribution, some time of course was saved in *not* switching out the defective car. One department saved time, but did the railroad in the end save or lose money? The answer is clear.

In many instances, the initial road or the road loading the car is at fault in not seeing that the load is properly placed in the car and, if necessary, doorway protection added. The initial road is not assessed with the cost of rearrangement and the application of doorway protection, but the second or third road handling the commodity has the revenue reduced very materially.

A number of cases of bad loads originate at stations where there is no inspector located and the agent passes judgment on the load, and he not being thoroughly conversant with the rules has insisted on the misapplication of the rules, where if he had taken the matter up with his superior officer and requested the services of a car inspector or other representatives thoroughly conversant with the rules, the load would have been properly loaded, the shipper satisfied and the load reached its destination much sooner and passed by a repair yard instead of into it for adjustment or possible transfer.

I will grant that it is a very easy matter to find bad conditions, but what we should all strive for is a remedy for the condition that now exists. I believe that it is the duty of each and every railroad to educate the shippers located on their lines in the proper method of loading material, both in open and closed cars. This can be done very easily by furnishing the industrial plants with a copy of the Master Car Builders' loading rules and delegating a representative of the railroad who is thoroughly familiar with the loading rules to instruct the shipper. I have had considerable experience along this line and while I have met with some objections from some of the shippers, the majority, however, have shown a willingness to co-operate with the railroad company in the proper loading and securement of their commodity so as to insure its reaching destination safely and without delay. Co-operation of the railroads along these lines at large terminals is absolutely necessary and what are the demands of one railroad along the lines of loading, if in strict accordance with the Master Car Builders' loading rules, should be the demands of each and every railroad in that district. In this manner, improper loading will be reduced to a minimum. It is, however, absolutely necessary that the representative who is delegated to impart the information to the shipper is thoroughly conversant with the loading rules, for the reason that I have found in some cases where inspectors or other railroad representatives have insisted on the shipper using a certain rule which did not apply to the particular load, the load being of such a nature that it would come in the category of a special load and good sound judgment required in deciding the securements necessary. I have also found that shippers have placed securements on the load that did not comply strictly with the cut in the loading rules covering the particular load, and in checking the securements they were found equally as strong, if not stronger.

In a large district such as this, it is surprising the number of foreign cars that are held in the shop and transportation yards awaiting disposition from the owner on account of their physical condition, and I can safely say without fear of contradiction that a large percentage of these cars started away from the loading point carrying a load and it was necessary to shop the cars and transfer all or part of the lading to make repairs, and in some cases the car never reached the destination intended with the load, the load going forward in another car.

During the past year I have had occasion to watch the physical condition of the box car, which I must say is deplorable. Box or house cars are placed on the shop tracks, end sheathing and siding renewed over posts and braces which are split and in a great many instances posts decayed at the base or ends. The car receives a load, bulges at the sides and ends, and in a great many instances claims result from loss or damage of commodity. I refer particularly to the time of the year when the demand is great for box cars for moving grain out of a lake port.

At one of the large terminals I made a check for a few days and the following number of cars were shopped on account of apparent improper loading, causing bulged doors, shifted loads, etc. Instead of showing the names of the road, I have used a numeral to represent them.

Road	Total Cars	Total Days Delay	Per Diem Expense	Cost Material and Labor	Total Cost	Av. Cost Material and Labor	Av. Cost Material and Labor per Day	Av. Cars per Day	Av. No. Days Delay per Car
1	13	36	$ 10.15	$ 18.02	$ 28.17	$1.39	$2.17	.4	3
2	296	395	106.05	296.18	402.23	1.00	1.35	10	1.3
3	39	45	15.75	34.68	50.43	.89	1.30	1	1.2
4	67	110	38.50	44.12	82.62	.66	1.23	2.2	2
5	104	205	61.95	211.54	273.49	2.03	2.63	3.5	2
6	11	42	11.90	18.12	30.02	1.65	2.73	.3	4
7	10	8	2.80	4.14	6.94	.41	.70	.3	1
8	20	22	6.65	13.68	20.33	.68	1.01	.6	1.1
9	18	18	4.20	18.06	22.26	1.00	1.23	.6	1
10	4	4	1.40	3.42	4.82	.85	1.20	.1	1
Total	582	885	$259.35	$661.96	$921.31	$1.14	$1.62	19	1.6

It is unnecessary for me to read this data, as it is self-explanatory.

Many cars pass from the initial road without the doors showing any signs of distress, i. e., bulged out, but at some point along the line, these cars had received service shocks which are incident to all cars, and the load shifted little by little until it reached the doors. As stated before, the initial road does not bear the expense of the cost of rearrangement or transfer; the burden is placed on some other line.

Of course, working under an agreement the same as in effect in the Chicago district, the delivering line passes the car on in order to expedite the movement of freight, which to my mind is

* Extracts from a paper read before the Car Foremen's Association of Chicago.

not expediting it because it does not make any difference whether a car of this kind lays two days in "A" road's yard for transfer or adjustment, or whether it lays in "B" road's yard for two days. The figures that I have given you in the above statement are correct in every detail and were obtained from an actual check.

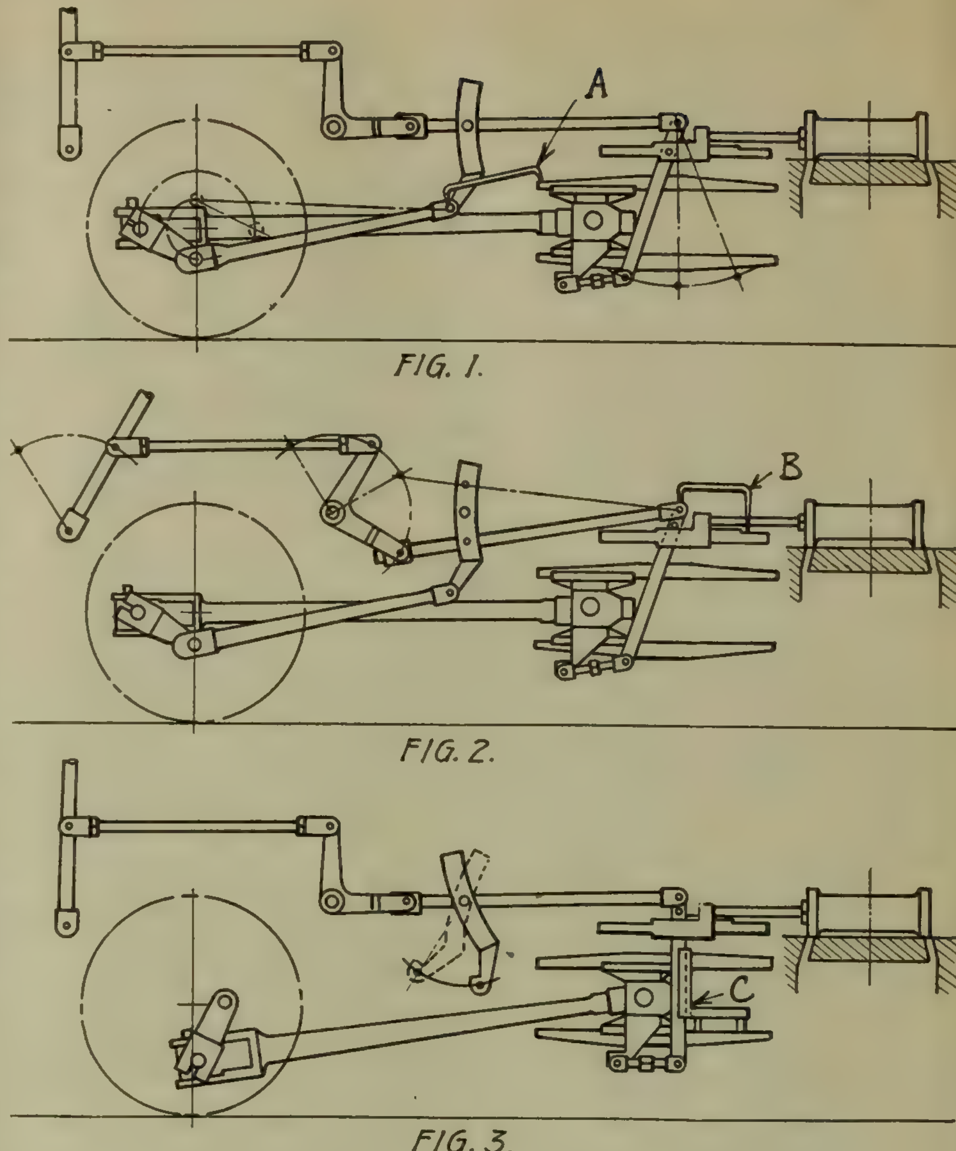
It has been found that at points where a car inspector is not located, loads are unevenly distributed in cars through the ignorance of the loader and also due to the agent not understanding the absolute necessity for a proper distribution of the lading, and a number of derailments have resulted from this cause. The disagreeable results obtained in these instances are the same as those mentioned earlier in this paper and I assure you that there is room for improvement along these lines.

This high class box car is the car that is fit to carry high class commodities, such as flour, grain, etc. A large number of railroads are placing in service new 80,000 and 100,000 pounds capacity box cars and the first load they receive is fertilizer, hides, oil and tar in barrels, destroying the car for the loading of high class commodities. Many of you undoubtedly have seen this class of car loaded with the commodities mentioned and adjacent to this car an old empty 60,000 pounds capacity car perfectly fit for the load of hides, etc.

During the next grain season, when box cars are scarce, those of you who have to look after the preparation of cars for grain keep a record of the number of good box cars you will have to turn down on account of bad odor. You will be surprised at the large number. Previous loads of fertilizer or hides did the job. This is food for thought.

INSTRUCTIONS FOR VALVE SETTING, C. N. R.

The following are the instructions given out by the mechanical engineer's office of the Canadian Northern for setting valves on locomotives equipped with Walschaert valve gears. The drawings are shown herewith.



Figures Accompanying C. N. R. Valve Setting Instructions.

Measure valves and seats, also combination lever, and see that they agree with drawings. Put main wheels on rollers, adjust main rod so as to equalize the travel of the crosshead between the striking points, put up all parts of the valve gear, using temporary adjustable union links. Find the exact front and back dead centres of the main crank pin in the usual manner, and mark them on the wheel with a tram from the frames, mark the guides showing the travel of the crosshead. Put the engine on one dead centre and with a convenient tram, put a mark on the guides or other stationary part, from the centre of the front pin of the eccentric rod "A" as in Figure 1; move the engine to the other centre and make a similar mark; these marks should coincide. If they do not, move the eccentric crank on the main pin so that the front end of the eccentric rod will be moved a distance equal to half the difference between the two marks and try again until correct. In order to save time, the operation of finding the dead centres and the correct positions of the eccentric cranks may be performed at the same time. Should it be necessary to move an eccentric crank, it is advisable to use a temporary fastening and make it permanent after the valves are set. Put the engine on either centre and move the reverse lever to extreme forward and backward positions, and with a tram make marks from the centre of the front pin in the radius bar to a fixed part of the engine (see Figure 2). If these marks do not coincide, the eccentric rod must be adjusted an amount equal to half the distance between the tram marks multiplied by the ratio of the link arm radius to that of the link block. Disconnect the front end of the eccentric rod, and put link block in the exact centre of the link. This can be ascertained by oscillating the link while placing the reverse lever in different positions until there is no motion to the combination lever. The link blocks on both sides of the engine must be in the centre of the link with the same position of the reverse lever. Should they not be so, adjustment must be made in the lifting device to bring them so. Get port marks on the valve stem or other convenient part in the usual manner, showing opening of steam and exhaust edges of the valve, also mark the point central between these edges. Put the crosshead in the middle of its travel and with straight edges on the lower guides, and a set square (see Figure 3, item "C"); adjust the temporary union link until a straight line through the two upper holes in the combination lever is square with the guides. Tram the position of the valve; if it is not central with the ports, adjust the valve stem so as to bring it so and move the port marks accordingly. To save time, only the port marks need be changed now and the valve stem can be adjusted later. The valves should now be run over to get different valve events. The lead should be equal at both ends and the same in all positions of the reverse lever, the port opening may be found to be more at one end than at the other, causing the other events to be unequal. If this is found to be the case, adjust the union link so as to bring the different events alike at both ends or nearly so, and this should not affect the lead to any extent. The valves may be considered correct when the cut-off and release in forward gear at 25% cut-off do not vary more than one inch (1") between the extremes of the four positions. The temporary adjustments should now be made permanent.

CAR INSPECTOR Henry Wagner was instantly killed in outbound yard on the 2nd inst. by being run over and dragged by a cut of cars. He was under a car fixing a brake rigging when the yard engine backed into the track with five or six other cars to push them into clear. Wagner failed to put out his blue flag, and although the cars only moved about a car length after he shouted, it was far enough to kill him instantly. This should impress all of us with the necessity of using the safety appliances supplied and following the rules laid down by the safety committee.—*Baltimore & Ohio Employes' Magazine.*

ALLEN'S FLUSH CAR DOOR.

By Ray B. Mould.

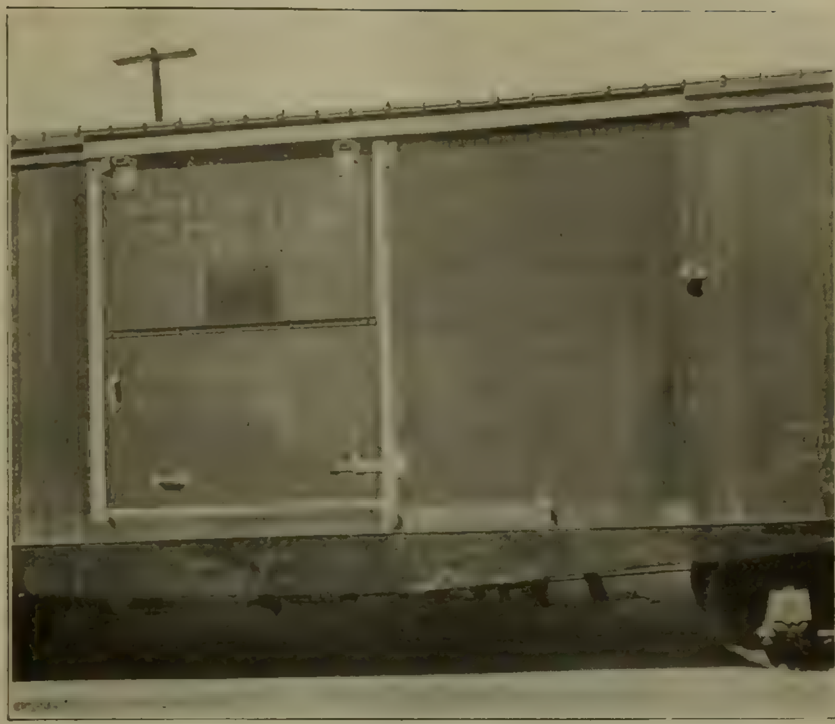
Pilfering of freight cars while in transit has always been one of the greatest troubles which the railroads of the country have had to contend with. Naturally the thieves always gained entrance through the door, the most of them being so expert that it was possible for them to open a car door, remove what freight they desired and replace the door in its former position without breaking the seal. Result: if a car thus pilfered had passed over three or four roads in making its journey there was a great deal of red tape, "tracers," denials of "our" line knowing anything about the shortage, etc., until each of the different lines paid their pro-rata share of the value of the stolen freight, and the shipper obtained his money months after the theft.

Railroad men have been trying for years to perfect a car door which could not be opened or tampered with without leaving evidence of its having been disturbed. They wanted also a door which could be depended upon to work at all times; one which would be proof against wind and rain as well as burglars.

At a recent convention of railroad officials, held in Los Angeles, a car door combining these features, was placed before the body of men for their inspection and met with the approval of all railroad men who inspected it. It is the invention of a Mr. Allen and is called the "Allen's Flush Car Door." It carries with it every good feature looked for by railroad officials; its original cost is but a fraction above that of the average door for freight cars, and it is claimed that it will save any railroad company this amount within a few months.

Its chief feature is that the door cannot be opened or tampered with unless the seal is broken. This is the first step toward eliminating burglary of freight cars. With the old type of car doors it was possible for car thieves to remove the lugs at the bottom of the door, swing the door back away from its fastenings, remove any or all pieces of freight from a car, replace the lugs and make their get-away without breaking the seal. If the car happened to be traveling over two or more railroad lines the loss would not be discovered until the car had reached its destination, and in 90 per cent of such cases it was impossible to ascertain where the robbery was committed.

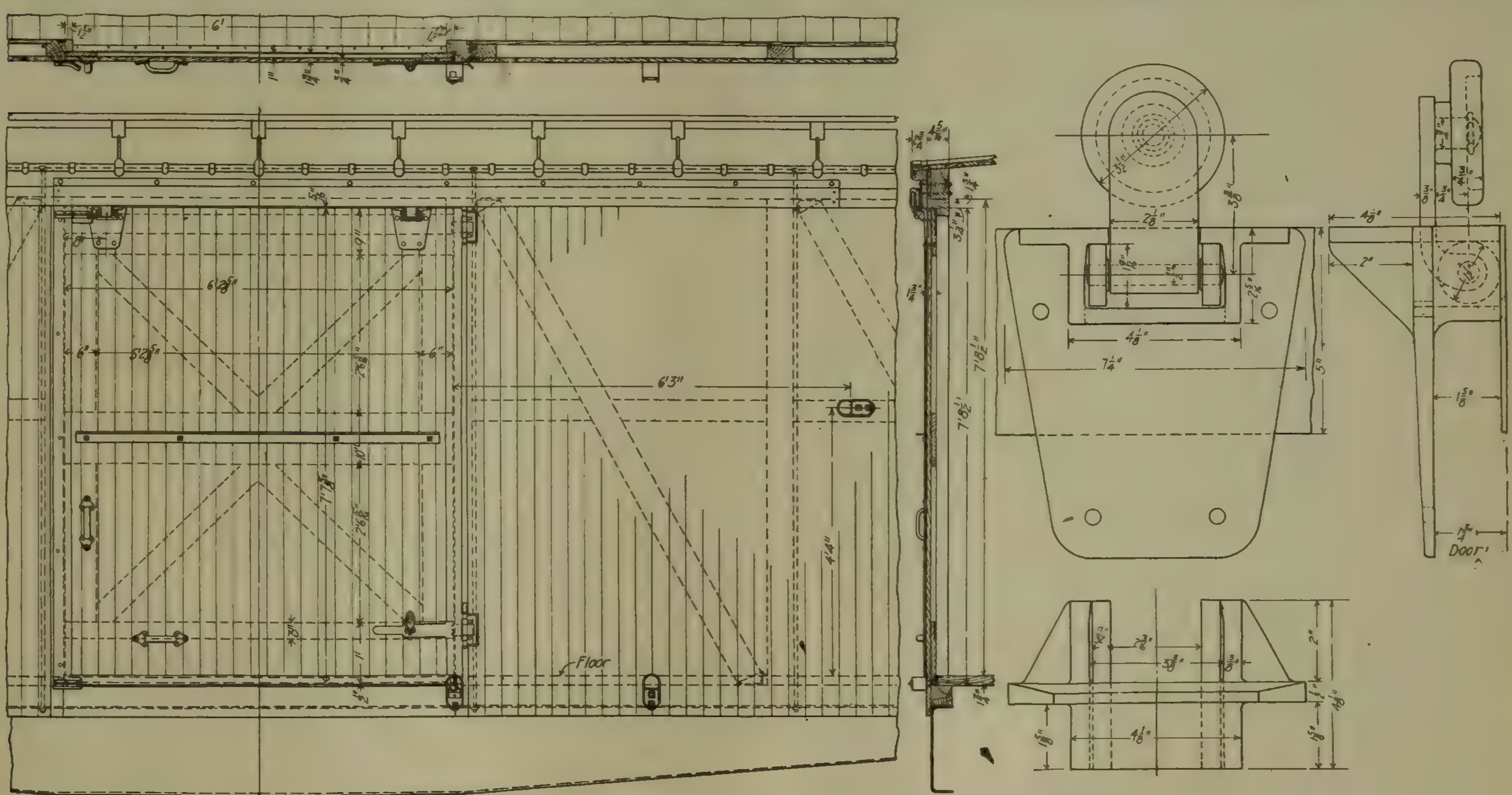
This is not possible with the Allen door. When the door is closed it slides into a steel groove at the top, bottom and one end of the door. The trainman then grasps the lever shown at the lower right hand corner of the door, gives it a quick turn to the left, and this automatically pushes the door into the groove, folds a steel strip over the other end of the door and the lever is locked shut with a small pin. The seal is then applied to pin, and as the only manner in which to open the door is by pulling out on the lever, the seal would have to be broken, and this fact would be discovered almost immediately.



Allen Flush Car Door on a Southern Pacific Car.

The door is now firmly locked in place; it does not protrude from the side of the car—eliminating wind resistance while the car is in motion—it cannot swing or jar loose from its fastenings to strike a person standing near a moving train, and top, bottom and both ends of the doors are covered with a heavy steel strap, shutting out heat, cold, wind and moisture. The inside of the door is smooth; it fits snugly on all four sides and is always ready for service of any kind.

Perhaps its most important feature is the ease with which the door may be operated. It travels on a covered track at the top of the car; there are no moving parts exposed to rain to become rusted, thereby necessitating damage to the side of the car by



Views of Allen Flush Car Door. Details of Hanger at the Right.

train and stationmen being forced to use iron bars to pry the door open or shut, and it is firmly locked in place at all times.

This is especially important when cars are empty and being switched about yards. The Allen door is locked into place when it is open, and it is necessary to pull a small lever, releasing a catch before the door can be closed. Of course, when empty cars are being moved in trains the rules require that all such doors be closed and fastened, but those rules require that each door be opened by a member of the train crew to make sure that the car is empty. This is a hard, arduous job with the present style of car door, but with the Allen working so easily it would be the matter of but a few moments for a trainman to inspect every car in his train. This, too, does away with trespassers riding in freight cars, as the door cannot be operated from the inside of a car and even should a "hobo" get in the car he could not close it behind him, as the working lever is on the outside of the door.

Details of the door are shown in the illustrations. A number of these doors are in service on the Southern Pacific.

INTERNATIONAL ENGINEERING CONGRESS, 1915.

The attention of the engineers of the world is being more and more drawn to the program of the International Engineering Congress which is to be held in San Francisco, Cal., in 1915. The interest which has been aroused in foreign countries is shown by the fact that at the present time there have been received enrollments and subscriptions from forty-two such countries. It is furthermore to be noted that of the present total enrollment, approximately 25 per cent is from countries other than the United States. The number of subscriptions from the members of the five national engineering societies of the United States under whose auspices and control the Congress is being held is, however, not so gratifying. The percentage of the total membership of these five societies represented by the subscription list is only 3.7, and this, although each individual member of these societies has received circular information and data concerning the Congress and has been urged to send in his subscription promptly.

It is probable that this is largely due to the fact that the date of the congress is still somewhat in the future, and also to the tendency of the individual to procrastinate. This, to a considerable degree, handicaps the work of the committee on management, and it is extremely desirable that as many as possible who intend to subscribe should do so at an early date.

The list of topics to be treated in the Section on Mechanical Engineering gives a very good idea of the character of the publications which it is intended to issue and the topics which will be presented and discussed at the meeting. These are as follows:

1. Recent progress and present status of foundry practice, and casting metals.
2. Recent progress and present status of the art of forging.
3. Equipment processes, and methods for the boiler shop.
4. Machine shop equipment, methods and processes.
5. Automatics.
6. Special processes for shaping and forming metals.
7. High temperature flames in metal-working.
8. Industrial management.
9. Safety engineering.
10. Industrial museums as an educational factor.
11. The steam engine of the year 1915.
12. The steam turbine of the year 1915.
13. The internal combustion engine of the year 1915.
14. Motors of the Diesel type.
15. The Humphreys gas pump.
16. The steam boiler of the year 1915.
17. Refrigeration.
18. Pneumatics.
19. Lubrication and lubricants.
20. Water wheels of pressure type.
21. Water wheels of impulse type.
22. Hydraulic power developments and use.
23. Power plant design.
24. Motor vehicles, passenger type.
25. Motor vehicles, utility type.
26. Motor tractors.

Many of these topics will be treated as symposiums with contributions representing the practice in more than one country.

The various sections outlined for the work of the Congress and the volumes to be issued are as follows:

Vol. I. The Panama Canal.
Vol. II. Waterways and Irrigation.
Vol. III. Municipal Engineering.
Vol. IV. Railways and Railway Engineering.
Vol. V. Materials of Engineering Construction.
Vol. VI. Mechanical Engineering.
Vol. VII. Electrical and Mechanical Engineering.
Vol. VIII. Mining Engineering and Metallurgy.
Vol. IX. Naval Architecture and Marine Engineering.
Vol. X. Military Engineering, and Miscellaneous.

It will be noted that the proceedings of the Section on Mechanical Engineering will be published in Vol. VI, with some of the papers falling into Vol. VII. It is also noted that Vol. X will consist only in part of Military Engineering and will also contain papers on miscellaneous topics which are not definitely associated with any of the various sections.

Full information concerning the congress may be obtained by addressing the committee of management as follows: International Engineering Congress, Foxcroft Building, San Francisco, Cal.

"CY" WARMANS' LAST POEM.

"Cy" Warman, well known as the author of many railroad stories and poems, died on April 7. His last poem, written about a month before his death, was recently published in the Baltimore & Ohio Employees' Magazine. It is entitled "Will the Lights Be White?" and is as follows:

Oft, when I feel my engine swirl,
As o'er strange rails we fare,
I strain my eye around the curve
For what awaits us there.

When swift and free she carries me
Through yards unknown at night,
I look along the line to see
If all the lamps are white.

The blue light marks the crippled car,
The green light signals "Slow,"
The red light is a danger light,
The white light, "Let her go."

Again the open fields we roam,
And when the night is fair
I look up in the starry dome
And wonder what's up there.

For who can speak for those who dwell
Behind the curving sky?
No man has ever lived to tell
Just what it means to die.

Swift toward life's terminal I trend,
The run seems short tonight;
God only knows what's at the end—
I hope the lights are white.

THE MASTER BOILER MAKERS' Association made the experiment this year of appointing small committees to handle the various topics, and the result was very gratifying to T. W. Lowe, the president, who made the appointments. The committee reports were in the hands of the secretary and were printed and distributed to the members six weeks in advance of the convention.

Training Apprentices on the Erie Railroad

By Wm. S. Cozad, Superintendent of Apprentices and Piecework.

The problem of fully supplying the ever increasing demand for thoroughly skilled and trained mechanics is probably further from solution at this time than ever before. For many years past it has caused a great deal of anxiety to the heads of large industrial corporations, and on every hand may be heard the remark that the ranks of the old-fashioned mechanics are becoming rapidly depleted.

The average boy, who, by circumstances over which he has no control, is forced out of school at an early age and compelled to take up his life work, has little to look forward to in the matter of education. If he has the will and the physical endurance he may study after hours, attending night school when possible and after a few years of unrelenting toil he may finally attain some general knowledge of a few primary subjects, all of which will probably be more or less imperfect.

To offset these bad results, various systems of industrial education have recently been developed, prominent among which is the method of training young men in the different trades by a regular course of apprenticeship which combines technical as well as practical training.

In keeping with this advanced movement, the Erie Railroad, a little more than five years ago, created an organization for the purpose of giving thorough technical and practical instruction to all young men who enter its service as apprentices, in the trades which they seek to learn.

In order to meet the heavy demands made on its shops on account of the large increase in business, requiring much more and heavier power, this company has within the past few years practically renewed all shop machinery on the entire system. Additions to shops and roundhouses, new power houses, new roundhouses and roundhouse machine shops have been built in order to provide for keeping in good condition the motive power and car equipment. This was necessary because every dollar of revenue from freight, which goes into the treasury must be earned by the locomotive.

Having, therefore, provided a full complement of tools and equipment, to obtain the greatest possible benefit from this investment it becomes necessary also to provide a competent corps of intelligent, skilled and careful workmen. With this object in view, it was decided in June, 1908, to establish a thorough apprenticeship system to train young men, not only to become competent and skillful in the mechanical arts, but to instill in them a proper interest in the business, loyalty to the railroad and familiarity with Erie standards and Erie methods.

The first school was established in the Meadville shop and the first class called for technical instruction at 9 a. m. on the 7th day of July, 1908. The schools were afterward extended to Hornell, Susquehanna, Dunmore and Port Jervis. These schools are free to apprentices in all departments and attendance is compulsory.

The company furnishes, free of charge, the class room, heat and light, drawing tables, drawing instruments, blackboards, stools, filing cabinets and all necessary material for conducting the school.

These schools are in charge of competent instructors and are open from September 1st to June 30th, inclusive. Each apprentice is required to attend the classes four hours per week, two hours on each of two different days, for which time he is paid at his regular hourly shop rate.

Instruction in these classes covers the fundamental rules of arithmetic, common and decimal fractions, proportion, simple problems in interest, weights and measures, the elementary principles of geometry, mechanical drawing, practical and theoretical sheet metal development, tin, pipe and copper work, and special instruction in Erie standard practices pertaining to the construction and maintenance of cars and locomotives, as well as lessons in the successful and economic operation of same.

Group of Apprentices at the Hornell Shops, Erie R. R.

The original organization consisted of:

1st. A supervisor of apprentices who was also the superintendent of the piecework system.

2d. An assistant supervisor of apprentices who was a mechanical engineer and thoroughly familiar with the standards of the mechanical department.

3d. A technical instructor for shops having fifty or more apprentices.

4th. A man possessing the combined practical and technical ability necessary to instruct in shops having less than fifty apprentices.

The above organization was effective approximately three years and proved very efficient in systematizing and extending the work, but since the text book containing all necessary technical instruction has been developed, and a well grounded set of rules and regulations laid down for the organization of the schools, it has been found advisable to reduce this organization, making it much less expensive, without in any way impairing the service.

Fifty per cent of all the operations in the shops of this company (car and locomotive work combined) are performed on a

Type of Boys Attracted by Erie Apprentice Schools. Most of These Boys Are High School Graduates.

time basis and as the instruction of apprentices and a systematic study of shop economy are very closely related, it was thought advisable to combine the two organizations. The supervising force as at present constituted consists, therefore, of:

1st. A superintendent of apprentices and piecework.

2d. Two inspectors of apprentices and piecework.

3d. Local instructors of apprentices who combine the necessary technical and practical training to successfully handle both class and shop instruction.

Before detailing the duties of the respective members of this organization, it is well to state that in addition to a general mechanical superintendent, there are three mechanical superintendents, one having direct charge of locomotive work, lines west from Salamanca to Chicago, one in charge of same work, lines east from Salamanca to New York, and one in charge of car work over the entire system. What now follows will be readily understood.

The superintendent of apprentices and piecework reports directly to the general mechanical superintendent, but he is required to work in harmony with the mechanical superintendents and they must agree on all rules and regulations in connection with the operation of the schools. Changes in standards or methods of conducting the work must be submitted jointly to the general mechanical superintendent for his approval before being made effective.

The superintendent of apprentices and piecework has charge of the practical and technical educational features of the system and deals directly with all problems affecting apprenticeship work. His duties are to outline the different courses of instruction both in the school and shop, organize all schools, see that the standing of each apprentice is kept according to prescribed rules, that apprentices are moved from one class of work to another according to the standard shop schedule and that apprentices in the different departments of the shop are given equal opportunity to advance in the trade. He must require that all school rooms are kept in a clean and sanitary condition, that apprentices take the proper care of all drawing instruments and other material furnished them by the company and insist on a strict adherance to all rules and regulations which must necessarily be followed in order to make the system a success. All business pertaining to the schools is transacted through the master mechanic or shop superintendent of the plant and he is held responsible for the technical and practical training of the apprentices under his jurisdiction.

Apprentice School Room, Susquehanna Shop.

The local instructors of aprentices are selected with special reference to their fitness to give necessary practical and technical instruction in the work of repairs and renewals to locomotive and car equipment. Some are graduates of a recognized technical college who have subsequently served time in the shop. Others are self made men who are not only thoroughly practical mechanics, but have by personal effort familiarized themselves with mathematics and mechanical drawing to the extent that they can successfully teach the lessons contained in the apprentice text book. The instructors devote one-half the day to technical instruction in the class room and the remaining half to practical instruction in the shop. They distribute all lesson sheets, require apprentices to do certain work at home, keep record of all examinations, make all monthly reports and account to the master mechanic for the daily performances of the apprentices.

ERIE RAILROAD COMPANY.

NEW JERSEY & NEW YORK R. R. — NEW YORK SUSQUEHANNA & WESTERN R. R. — CHICAGO & ERIE R. R. — COPY

Service Record of Charles Anthony Perry Apprentice at Susquehanna Shop.

Year 1911 - 1912

Month	Class of Work	Shop: Days Worked	Shop: Efficiency	Class: Standing in Mathematics	Class: Classes Missed	Class: Standing in Drawing
May	Heating Brts Ash Pans	5	80			C
June	"	26	75	94		C
July	"	22	75			
Aug.	Boiler Work Settings	25	75			
Sept.	"	25	80	81	2	C
Oct.	Ash Pans Settings	24	80	40	1	C
Nov.	"	24	80	75	1	C
Dec.	General Boiler Work	22	95	85	1	C
Jan.	"	25	90	91	5	B
Feb.	Patch Work	20	95	87	2	B
Mar.	" "	25	95	90	4	B
Apr.	" "	14	93	90	1	B
Total		249	85	82	15	C
Days to Complete Year		51				
Personality	A A A A [illegible] A					
Rate per Hour						

Year 1912 - 1913

Month	Class of Work	Shop: Days Worked	Shop: Efficiency	Class: Standing in Mathematics	Class: Classes Missed	Class: Standing in Drawing
May	Flue Work Flue Sheets	27	95	90	2	B
June	" "	19	94	86	2	B
July	General Boiler Work	10	94			
Aug.	" "	26	95			
Sept.	New Firebox Work	20	96	86	2	B
Oct.	"	25	96	75	5	B
Nov.	"	16	80	90	4	B
Dec.	"	21	85		2	B
Jan.	"	17	82	50	5	B
Feb.	General Boiler Work	19	85	50	5	B
Mar.	"	9	90	50	5	B
Apr.	"	21	90	82	2	B
Total		478	81	73	30	B
Days to Complete Year		122				
Personality	A A A A B A B B BA					
Rate per Hour						

Year 1913 - 1914

Month	Class of Work	Shop: Days Worked	Shop: Efficiency	Class: Standing in Mathematics	Class: Classes Missed	Class: Standing in Drawing
May	General Boiler Work	10	90	91	6	B
June	On leave of Absence					
July	General Boiler Work	20	90			
Aug.	"	24	90			
Sept.	"	22	90	50		B
Oct.	New Firebox Work	22	95	94	6	C
Nov.	"	19	97	92	2	C
Dec.	General Boiler Work	14	98	94	1	B
Jan.	"	25	98	93	1	B
Feb.						
Mar.						
Apr.						
Total						
Days to Complete Year						
Personality	B A A B A A					
Rate per Hour						

EFFICIENCY. TO BE BASED ON QUALITY AND QUANTITY OF WORK WHERE 100 P. C. WILL EQUAL NORMAL OUTPUT.
DRAWING
PERSONALITY A—EXCELLENT B—GOOD C—FAIR D—UNSATISFACTORY E—FAILURE

Service Record Card.

COPY

Year		Shop: Days Worked	Shop: Efficiency	Class: Standing in Mathematics	Class: Classes Missed	Class: Standing in Drawing
Month	Class of Work					
Total						
Days to Complete Year						
Personality						
Rate per Hour						

Name Charles Anthony Perry Shop Susquehanna
Age 19 years Nationality American
When and where born Susquehanna, Pa., February 2nd, 1892
Name and address of parents if living, if not nearest relatives
Mrs. M. Perry, 321 Laurel St., Susquehanna, Pa.
Parents occupation ------
Living at home or boarding Living at home
Years in Grammar School Nine High School None
Evening courses attended None
Preparation in arithmetic To denominate numbers
Preparation in algebra None
Time elapsing between leaving school and entering apprenticeship Four years
First entered service at Susquehanna
Date May 1st, 1907, as Helper, Printing Dep't.
Rate $15 per mo. Reason for leaving Transferred to Stores Dep
Commenced apprenticeship May 29th, 1911.
Department Boiler Shop
Completed apprenticeship
SPECIAL APPRENTICE
Graduate of Date
Course
Previous practical experience
Remarks: Transferred from Stores Dept. to apprentice May 29th, 1911.

Reverse Side of Service Record Card.

★ Form 3080—7, '11—1000

ERIE RAILROAD COMPANY.

NEW JERSEY & NEW YORK R. R. CHICAGO & ERIE R. R.
NEW YORK, SUSQUEHANNA & WESTERN R. R.

SHOP AND CLASS RECORD OF APPRENTICES AT

__________Shop, Month Ending__________191__

NAME OF APPRENTICE	SHOP			CLASS			
	CLASS OF WORK	Days Worked in Shop	Efficiency	Standing in Mathematics	Classes Missed	Standing in Drawing	Personality

No. of Apprentices employed during Month, Resigned,

"Efficiency" of apprentice to be based entirely on quality and quantity of work, where 100% will equal a normal output.
Drawing, Personality } A, perfect; B, good; C, fair; D, unsatisfactory; E, failure.
Mathematics } 10% to be allowed for neatness of work, and problems to be graded according to percentage solved correctly in each lesson.

Practical Instructor of Appr. Technical Instructor of Appr.

Master Mechanic.

Form Used by Local Officers for Reports.

The inspectors of apprentices and piecework report directly to the superintendent of apprentices and piecework. They make frequent visits to the different shops and their duties in relation to the apprentice system are to become personally acquainted, as far as possible, with the apprentices in all departments and engage them in conversation as to progress made, examine conditions, study their work, see that changes are made from one class of work to another as per shop schedule, consult the master mechanic, general foreman, and local instructor as to work accomplished both in class and shop, and report their findings from time to time to the superintendent of apprentices. All matters requiring attention are then taken up with the local officer for proper adjustment.

The local instructor of apprentices makes out a detailed report at the end of each month which shows work performed by each apprentice both in class and shop. This report is forwarded through the master mechanic to the office of superintendent of apprentices and piecework, where the information is transferred to a card record and from this record it may be determined at any time whether the apprentice is receiving necessary advancement from one class of work to another as per shop schedule.

Apprentices are required to serve a term of three years of 300 days each, unless they can qualify in a shorter period; the number of hours worked by the shop to constitute a day. Although

★ Form 3819 SHEET No. 8.

SPECIAL APPRENTICES

Locomotive Department

DEPARTMENT	1ST YEAR	SHOP EFFICIENCY	2D YEAR	SHOP EFFICIENCY	3D YEAR	SHOP EFFICIENCY	EMPLOYED	RESIGNED
Erecting Shop								
Machine Shop								
Boiler Shop								
Blacksmith Shop								
Vise Work								
Roundhouse								
Special Work on Line, or in Test Department								
TOTAL								

Car Department

Freight Repairs, to include Wood and Steel Car Work								
Mill Work								
Passenger Car Platforms and General Body Work								
Paint Shop								
Helping Cabinet Maker, which will include Stripping and Trimming Cars								
Bench Work								
TOTAL								
TOTAL SPECIAL APPRENTICES								

SUMMARY

CLASS	1ST YEAR	AVERAGE EFFICIENCY		2D YEAR	AVERAGE EFFICIENCY		3D YEAR	AVERAGE EFFICIENCY		4TH YEAR	AVERAGE EFFICIENCY		TOTAL NO.	EMPLOYED	RESIGNED
		SHOP	CLASS		SHOP	CLASS		SHOP	CLASS		SHOP	CLASS			
Jersey City															
Bergen															
Port Jervis															
Dunmore															
Susquehanna															
Elmira															
Hornell															
Avon															
Buffalo															
Bradford															
Salamanca															
Kent															
Meadville															
Brier Hill															
Cleveland															
Galion															
Marion															
Huntington															
Dayton															
[illegible]															
N. Paterson															
Stroudsburg															
TOTAL															

This general statement is compiled in the office of the Superintendent of Apprentices quarterly from information contained on form 3080, Shop and Class record of apprentices, (See Exhibit) which is furnished by the local shops, and forwarded to all general and local officers who are in any way connected with apprentice work.

the specified course is based on a period of three years, apprentices who diligently apply themselves to the work in school and shop are invited to request a change from one class of work to another at any time they feel confident of the work in hand and at the end of the second year or any time thereafter, they may make application in writing to their instructor for promotion from apprentice to mechanic. If in the opinion of the instructor, the apprentice is worthy of promotion, he is recommended to the master mechanic, who, if satisfied as to the ability of the applicant, makes up the necessary form, which is subject to the approval of the mechanical superintendent and superintendent of apprentices. Apprentices who complete the course as indicated by the award of a certificate of apprenticeship and continue in the employment of the company are given the journeyman's rate in

★ Form 3120—1, '09—1000

ERIE RAILROAD COMPANY.

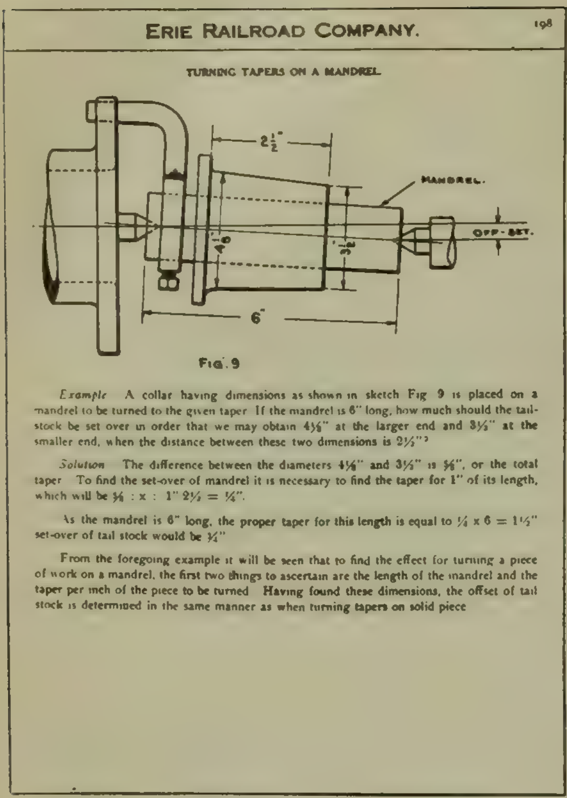
NEW JERSEY & NEW YORK R. R. CHICAGO & ERIE R. R.
NEW YORK, SUSQUEHANNA & WESTERN R. R.

Daily Attendance Record and Standing in Mathematics of Apprentices in__________Shop, Month Ending__________190__

MONTH	DATE			DATE			DATE			DATE			DATE			DATE			DATE			DATE			DATE			PERCENTAGE IN MATHEMATICS
NAME	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	ADT.	IN	OUT	

Adt.—Attendance "In," "Out," refers to problem sheets, number of sheet to be placed in space under heading.

Form for Keeping Record of Problem Sheets, Daily Attendance, etc.



ERIE RAILROAD COMPANY. 198

TURNING TAPERS ON A MANDREL.

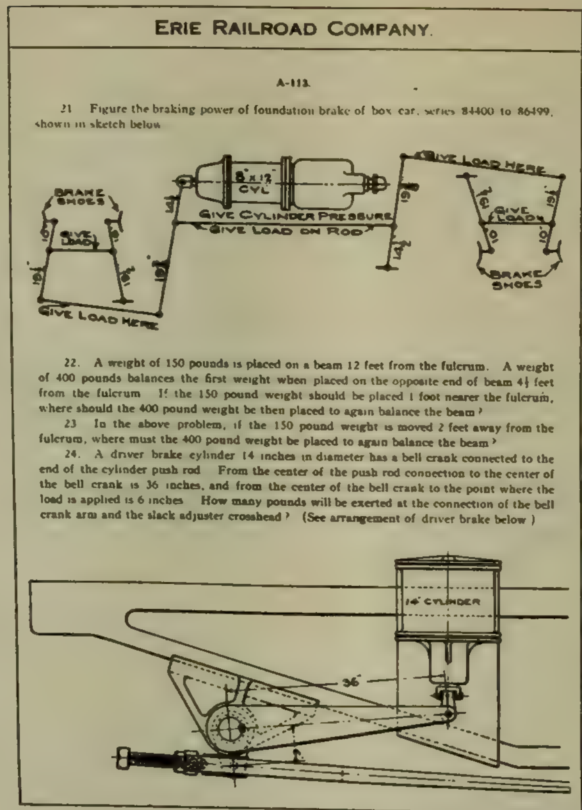
FIG. 9

Example A collar having dimensions as shown in sketch Fig 9 is placed on a mandrel to be turned to the given taper If the mandrel is 6" long, how much should the tail-stock be set over in order that we may obtain 4⅛" at the larger end and 3½" at the smaller end, when the distance between these two dimensions is 2½"?

Solution The difference between the diameters 4⅛" and 3½" is ⅝", or the total taper To find the set-over of mandrel it is necessary to find the taper for 1" of its length, which will be ⅝ : x : 1" 2½ = ¼".

As the mandrel is 6" long, the proper taper for this length is equal to ¼ x 6 = 1½" set-over of tail stock would be ¾"

From the foregoing example it will be seen that to find the effect for turning a piece of work on a mandrel, the first two things to ascertain are the length of the mandrel and the taper per inch of the piece to be turned Having found these dimensions, the offset of tail stock is determined in the same manner as when turning tapers on solid piece



ERIE RAILROAD COMPANY.

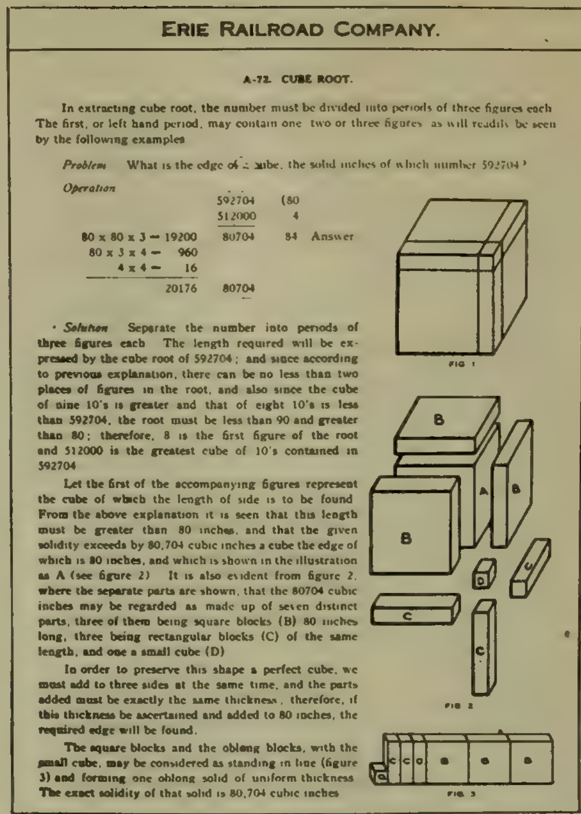
A-113.

21 Figure the braking power of foundation brake of box car, series 84400 to 86499, shown in sketch below

22. A weight of 150 pounds is placed on a beam 12 feet from the fulcrum. A weight of 400 pounds balances the first weight when placed on the opposite end of beam 4½ feet from the fulcrum If the 150 pound weight should be placed 1 foot nearer the fulcrum, where should the 400 pound weight be then placed to again balance the beam?

23 In the above problem, if the 150 pound weight is moved 2 feet away from the fulcrum, where must the 400 pound weight be placed to again balance the beam?

24. A driver brake cylinder 14 inches in diameter has a bell crank connected to the end of the cylinder push rod From the center of the push rod connection to the center of the bell crank is 36 inches, and from the center of the bell crank to the point where the load is applied is 6 inches How many pounds will be exerted at the connection of the bell crank arm and the slack adjuster crosshead? (See arrangement of driver brake below)



ERIE RAILROAD COMPANY.

A-72. CUBE ROOT.

In extracting cube root, the number must be divided into periods of three figures each The first, or left hand period, may contain one two or three figures as will readily be seen by the following examples

Problem What is the edge of a cube, the solid inches of which number 592704?

Operation

	592704	(80	
	512000	4	
80 x 80 x 3 = 19200	80704	84	Answer
80 x 3 x 4 = 960			
4 x 4 = 16			
20176	80704		

Solution Separate the number into periods of three figures each The length required will be expressed by the cube root of 592704; and since according to previous explanation, there can be no less than two places of figures in the root, and also since the cube of nine 10's is greater and that of eight 10's is less than 592704, the root must be less than 90 and greater than 80; therefore, 8 is the first figure of the root and 512000 is the greatest cube of 10's contained in 592704

Let the first of the accompanying figures represent the cube of which the length of side is to be found From the above explanation it is seen that this length must be greater than 80 inches, and that the given solidity exceeds by 80,704 cubic inches a cube the edge of which is 80 inches, and which is shown in the illustration as A (see figure 2) It is also evident from figure 2, where the separate parts are shown, that the 80704 cubic inches may be regarded as made up of seven distinct parts, three of them being square blocks (B) 80 inches long, three being rectangular blocks (C) of the same length, and one a small cube (D)

In order to preserve this shape a perfect cube, we must add to three sides at the same time, and the parts added must be exactly the same thickness, therefore, if this thickness be ascertained and added to 80 inches, the required edge will be found.

The square blocks and the oblong blocks, with the small cube, may be considered as standing in line (figure 3) and forming one oblong solid of uniform thickness The exact solidity of that solid is 80,704 cubic inches

FIG 1

FIG 2

FIG 3

Some Pages From Apprentice Text Book.

the shop in which they are employed, the rate being based on ability and merit.

Apprentices are subject to the same regulations in regard to advancement as any other employe of the company and must show some aptitude for the work in which they are engaged. Their conduct, punctuality and attendance both in school and shop must be satisfactory; failing in this, they are not retained in the service.

Boys making application for the position of apprentice in any trade are sent directly to the instructor of apprentices who examines them as to their general efficiency. If he finds that they are qualified for the position sought, they are given a certificate to the proper officer and the applicant may enter the service pending ratification by the employment bureau.

In some shops where no schools are in progress, the ranking officer personally examines applicants for apprenticeship and report of same is made to the superintendent of apprentices on the regular blank form provided for that purpose.

Employment is on approbation and if at the end of three months the apprentice does not develop a capacity to learn the class of work to which he has been assigned, he will not be continued in the service as an apprentice. At the expiration of three months, which is the trial period, if the applicant gives promise of becoming a good workman and has the ability to successfully handle the school work, he is thence forward regarded as a regular apprentice and entitled to all the advantages of apprentices in his class.

Boys must not be less than 16 nor more than 21 years of age to enter the service as apprentices and preference is always given the sons of employes.

Apprentices are not assigned to night work except in case of emergency and then not for a longer period than four consecutive nights. No allowance is made to apprentices for overtime worked and no reduction made for reduced working hours.

The efficiency of apprentices in the shop is based entirely on the quality and quantity of work where 100% equals the amount of work which could be accomplished by the average mechanic in a certain fixed time.

The class work is marked in accordance with the progress made and extends by intermediate steps from perfect to failure. In problem work 10% is allowed for neatness and the grading is based on the percentage of problems solved correctly in each lesson.

A shop schedule for the various trades has been carefully prepared and forms a very important part of apprentice training. When apprentices have served the required time on one particular branch of the work, it may not be advisable, for good and sufficient reasons, to immediately change them to new duties. It also occurs that on account of the very valuable service rendered by an industrious apprentice on work with which he is familiar, the foreman is not always either anxious or willing to make a change which will not only result in temporarily decreasing his output, but also that of the apprentice who follows him.

The shop record, however, is carefully maintained and in the exceptional cases such as outlined above the change is made at the first available opportunity.

The shop schedule is based on a course of three years, but until recently it was found necessary to carry many of the boys

A Class at Work, Meadville Shops.

Apprentice School Room at Dunmore Shops.

into and occasionally to the end of the fourth year because of improper advancement prior to the organization of the schools, and in all cases of this kind the fourth year has been spent in familiarizing the apprentice along new lines of work.

Our experience in this work, however, has proven conclusively that a reasonable adherance to the three-year shop schedule along with careful, practical training by the instructor and foremen, is sufficient to give the average apprentice a general knowledge of the trade which he seeks to learn. Having been properly trained along theoretical and practical lines, the award of a certificate of apprenticeship means to its recipient added responsibilities and if he is interested in the work he will usually continue his studies along the lines of his chosen profession.

The shop schedules follow:

MACHINE SHOP.

Lathe (bolt lathe first, then general work)	6 months
Planers	3 months
Shaper	3 months
Slotter	2 months
Boring mill	2 months
Vise work on rods	3 months
Vise work on motion work, pistons, crossheads, etc.	4 months
	23 months

ERECTING SHOP.

Frame work, shoes and wedges, wheeling engines, putting up spring rigging, engine truck work, expansion gear, etc.	6 months
Work above running board, consisting of hand rails, pops, whistles, boiler mounting and all similar work.	3 months
Putting up motion work, setting valves, lining guides, putting in pistons, applying steam chests, etc.	4 months
	13 months

BLACKSMITH SHOP.

Running steam hammer	6 months
Heating bolts	3 months
Helping on small fires	6 months
Running bolt heading and small forging machines	3 months
Light work on small fire with helper	6 months
Helping on tool fire	4 months
Heavy work on open fire, not requiring any special skill.	8 months
Total	3 years

BOILER SHOP.

Heating rivets and helping at light work on punch and shear, scaling boilers, etc.	4 months
Ash pan and netting work, also as much miscellaneous sheet iron work as possible	6 months
New firebox work, reaming and tapping staybolt holes, running in, setting and cutting off staybolts, etc.	4 months
Helping to scarf, roll, fit, shear, apply rivets and caulk new firebox or new sheets	6 months
Setting flues	3 months
Helping on flange fire	3 months
Working with boilermaker on general work, such as flanging, riveting, applying new sheets, bracing and staybolt work	10 months
Total	3 years

TIN AND PIPE WORK.

Helping on pipe work	8 months
Jacket and sheet iron	6 months
Injector and lubricator pipes, copper pipes in cab	8 months
Air brake pipes	6 months
Tin roofing, headlights, classification lamps, lanterns, oil cans and light tin work in general	8 months
Total	3 years

PAINTERS.

Helping in general, burning off, mixing paint	6 months
Rough stuff and plain painting	6 months
Sash and varnish work	6 months
Graining, filling and polishing	6 months
Lettering, staining and stripping	6 months
Varnishing and general work	6 months
Total	3 years

CABINET MAKERS.

Helping cabinetmakers	6 months
Running machines	6 months
Stripping cars	6 months
Bench work	6 months
Trimming cars	12 months
Total	3 years

PATTERNMAKERS.

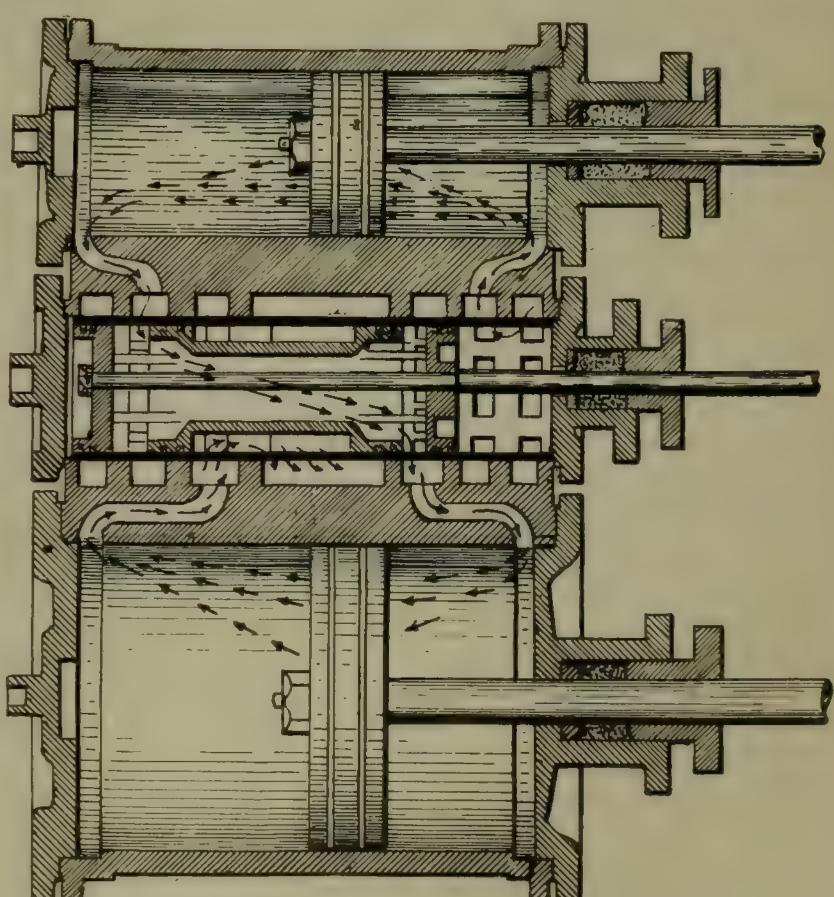
Helping in general work in pattern shop	12 months
Helping in foundry	4 months
Machine work	4 months
Bench work in general in pattern shop	16 months
Total	3 years

FOUNDRY.

Helping around shop	3 months
Light moulding	6 months
Core making and loan work	6 months
Machine moulding	3 months
Furnace work	6 months
General work	12 months
Total	3 years

SURFACE TABLE AND MACHINERY REPAIR WORK.

In the large shops at least one apprentice is kept on the surface table at all times. He is under the instruction of the machinist in charge of laying out work. Not all apprentices can be assigned to this work, but a sufficient number are trained to fully supply the requirements of the plant. In the small shops, apprentices in their third year are assigned to laying out work and when they have served three to six months, their place is filled by another apprentice.



Drawing Showing Steam Distribution in Compound Cylinders Made by 2nd Year Apprentice at Meadville Shops.

The Right Way.

In the machinery repair gang of the large shops at least two third-year apprentices are assigned for a period of three months each, at the end of which time they are succeeded in turn by third-year boys from some other department.

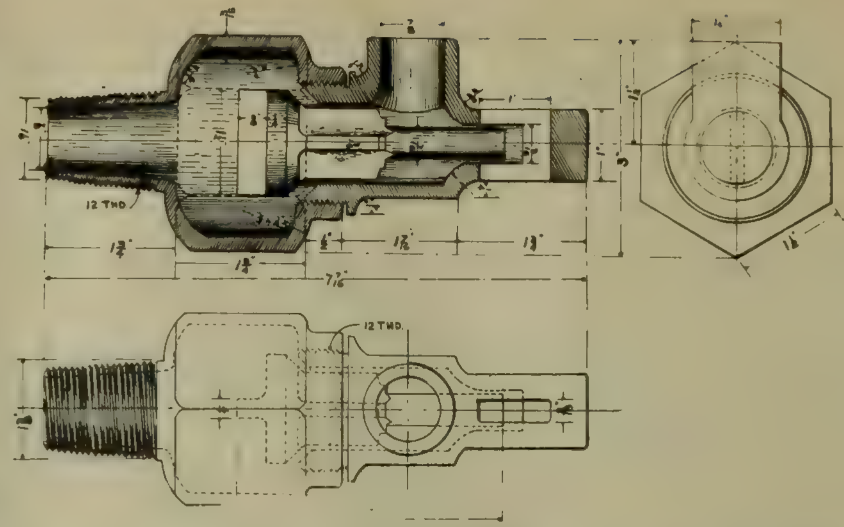
As an illustration of the methods used in following out the foregoing shop schedules, the record of a boilermaker apprentice in the Susquehanna shop is given on page 186.

The following statement will show briefly the results which have been obtained by a careful and systematic study of details in their relation to apprentice training and the resultant effect of maintaining an efficient corps of mechanics in the service:

Number of apprentices, all classes, on pay roll January 1, 1908	298
Number of apprentices, all classes, on pay roll January 1, 1914	447
Number of apprentices granted certificates July 1, 1908, to January 1, 1914	362
Number of apprentices granted certificates at end of 2nd year	6
Number of apprentices granted certificates while in 3d year	70
Number of apprentices granted certificates at end of 3d year	87
Number of apprentices granted certificates while in 4th year	151
Number of apprentices granted certificates at end of 4th year	48
Percent of apprentices granted certificates who are still in the service	60
Number of special apprentices (graduates of recognized technical colleges) in service January 1, 1914	24

A certificate of apprenticeship is granted apprentices in every department who satisfactorily complete the course of instruction. This certificate bears the personal signature of the general foreman, master mechanic, mechanical superintendent, general mechanical superintendent and is approved by the superintendent of apprentices. It carries with it a bound copy of the apprentice text book together with a complimentary letter, setting forth in detail the progress made by the bearer while engaged in learning the trade.

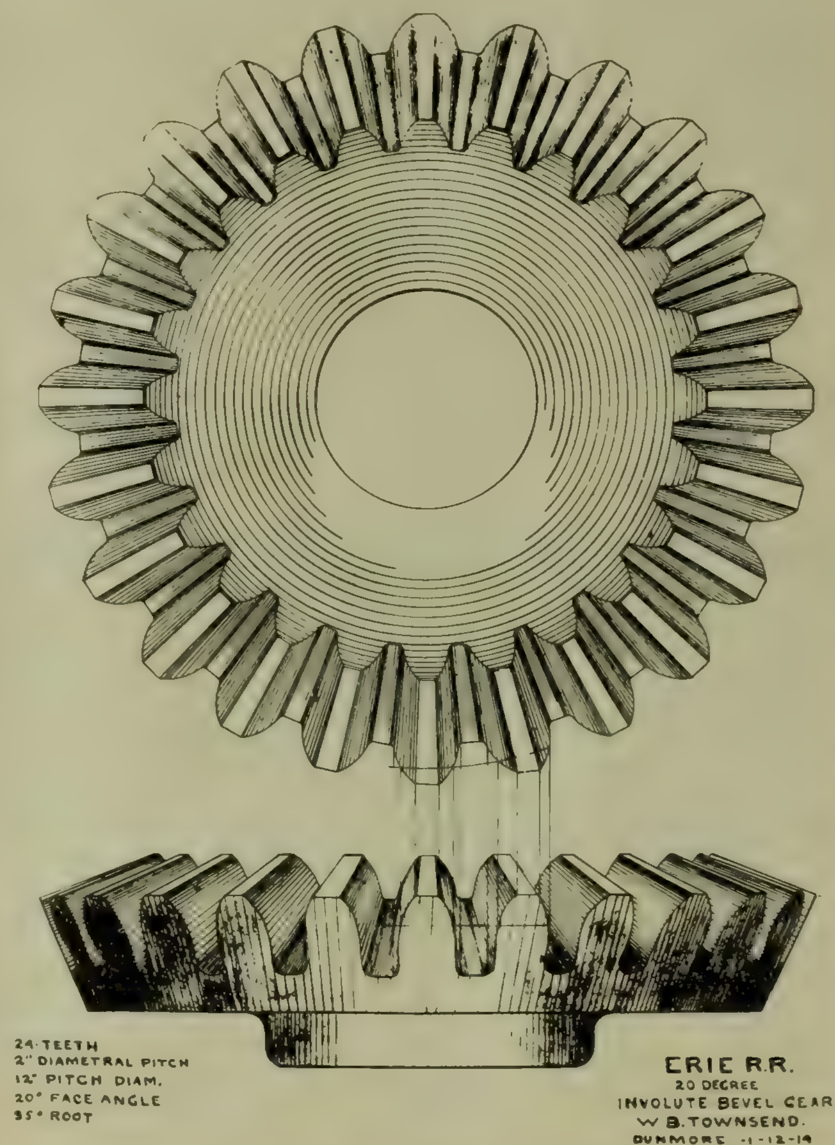
From six to eight apprentices are kept in the drafting department at all times where they are taught blue print work, detail drawing, standards of design and construction, etc. They are drawn from the different shops over the system and are required to spend six months in this department. This at once provides each shop with young men capable of making such miscellaneous sketches and drawings as may be required by the master mechanic or shop superintendent.



Drawing of Cylinder Cock Made by Apprentice at Meadville Shops.

Methods of instruction both in the shop and class room are simplified as much as possible. In the school each apprentice, no matter in what department employed, is required to make a freehand pencil sketch of such miscellaneous parts as a crosshead, cylinder head, angle cock, gauge cock, boiler check, eccentric strap, eccentric, and many others of similar nature. When this sketch has been completed and necessary dimensions supplied, the object is taken away and the apprentice is required to make a complete detail drawing from the sketch, showing each part assembled in its proper place. Drawings thus completed are submitted to the master mechanic for his personal inspection and occasionally they are forwarded to the superintendent of apprentices.

Our school rooms are all equipped with a sectional model of air motor, air hammer, injector, pop, whistle, triple valve, pump gov-



Drawing by an Apprentice at Dunmore Shops.

ernor, engineer's valve, lubricator and similar parts used in the operation of the locomotive. All classes of apprentices are taught the uses and abuses of these parts both from the models and also in practice in the shop. Other apparatus for instruction consists of lantern slides, files, chisels, hammers, taps, drills, square, calipers, boiler punches, reamers, samples of the various sizes of square and hexagon nuts, models of block and fall, brake leverage, outside valve gear, link motion, compound cylinders, gas engine charts, dynamo charts, steam turbine charts, valve setting charts, superheater charts, etc. These models or samples are used in imparting instruction with reference to the proper use and care of

Class at the Port Jervis Shop.

same. This is especially true of small tools, where particular instruction is given with reference to using same so that maximum amount of work may be obtained without destroying the tool.

The primary aim of the school is to teach by actual example as far as possible, or by the use of a model or chart. As an illustration: The lever is found at work in almost every machine used. It is of first importance, therefore, that the boy obtain a lasting impression of the lever at work, so that he will recognize it again when it appears in another form. In other words, he must be able to understand the principle of the lever, the pulley block, the incline plane, the screw, the wedge, etc. If he does not have mechanically constructed models to illustrate these principals the study becomes dull and uninteresting.

In the shop, boys as a rule work with skilled mechanics; this is particularly true in erecting and vise work, boiler making and blacksmithing. This course is followed out until the boy can show that he is able to do the work alone. Then if the mechanic should take a day off, the boy is placed on the work along with another apprentice. This immediately places him on his merits and he at once becomes an instructor to the apprentice assisting him.

The instructor of apprentices follows the practical work of each apprentice in detail to see that he thoroughly understands how to perform the operations correctly and in proper time and by this means the average boy becomes thoroughly familiar with the various classes of work covered by his trade. Even valve setting, once known only to the foreman and performed in strict secrecy, becomes as easy to the modern apprentice as lining guides, laying out shoes and wedges, or applying a set of pistons.

It will be found that apprentices receiving practical training along these lines will perform the larger part of the operations on a locomotive in about the same time as required by the average mechanic, and that the quality of the work will pass required inspection.

The blank forms submitted in connection with this article are sufficiently plain not to require a detailed explanation. The pictures represent actual every-day conditions among apprentices in our various shops, and the drawings have been selected from the large number which have accumulated in the files of the superintendent of apprentices and were not, therefore, prepared specially for any particular exhibit or purpose.

PRESENT-DAY RUNNING REPAIRS.*

By W. E. Dunham, Supervisor M. P. & M., C. & N.-W. Ry.

With the almost universal change in the type and arrangement of running gear and valve motion of the American locomotive that has taken place during the past few years, there has also developed a maintenance situation that calls for a considerable re-organization and re-arrangement of many divisional shop forces.

On some roads where it was considered that a locomotive should receive general overhauling once a year at least and one intermediate heavy repairing also, we find that the time between general repair shopping has been extended to two years, and the intermediate repairs made in the round house as running repairs. Where 75,000 miles was the limit for giving passenger locomotive general overhauling, many of them are now making 150,000 miles between shoppings and a similar proportion is resulting in the case of freight power. In fact in some "good" water districts the boiler is the controlling factor now in shopping rather than the machinery, as was formerly the case.

To meet this situation there naturally has resulted a tendency toward spreading out of shop facilities rather than concentrating them all at one or a few points. Divisional shops have been provided with facilities for handling the naturally heavier power, and the local organization has been prompt to make full use of such facilities, leaving for the "back shop" only such work as was beyond their capacity.

This change may, in some cases, have come about so gradually as to be hardly noticed from day to day or month to month, but if the organization at many terminals is checked as to yearly or bi-yearly periods, it will generally be noticed that at the smaller terminal roundhouses there is much more of the "back shop" work being done as "running repairs" than was formerly the case with engines equipped with the Steenson link motion.

Your superintendent of shops will, no doubt, also call your attention to the fact that there is a larger proportion of general repair engines turned into the shops under the present condition than there was under the former, and this is as it should be, because by following up the small repairs to the running gear of a locomotive, the proverbial "nine stitches" to be taken in the back shop will be saved, the locomotive will be kept in service more regularly and in the end the cost per unit of engine-mile or even ton-mile will be reduced.

We doubt very much whether this particular feature was taken into serious consideration at the time that the outside valve gear was introduced, in fact it is generally conceded that its adoption was the result of a mechanical necessity, rather than intended shop or steam economy. The fact remains, however, that there is a large decided shop economy in the outside gears with their pin and bushing connections that are readily accessible, easily renewed and open at all times to close inspection. No shop or roundhouse that has handled both the inside and outside gear, would ever be in favor of discarding the present outside gear for the old inside.

With this striking example before us, it is our desire to call attention to locomotive design in general and in some detail where we believe considerable economies can be obtained if the matter of the care of running repairs is given close attention, instead of no attention at all and being allowed to shift for itself. The results obtained in the past under the conditions imposed are a monument to the ingenuity and resourcefulness of our roundhouse foreman and it is time that we came seriously to his rescue.

The care required to keep up the pin connections of driver brake rigging, particularly in the numerous levers and hangers, is no small bug-bear to the average roundhouse foreman. In most cases we find that it is the usual practice to permit these parts to wear to the yielding point or until the holes in the several parts are so out of shape and oblong that extensive repairing, if not entire renewal, is required. The parts then have to be taken down, sent to the blacksmith shop, have the hole welded up, a new hole drilled and a new pin fitted. If, on the other hand,

* A paper read before the Western Railway Club.

the rigging had been originally constructed with standard bushings and pins throughout, it would not need very much stretching of the imagination to realize the ease and promptness of making repairs by going to the storekeeper, getting a new standard bushing and a new pin, press the old bushing out and the new one in place in one operation, and send the parts out with full section of original material and just as good as new. In many instances the parts would not have to be taken down, as repairs could be made in place with proper tools arranged. It is no doubt true that the first cost of a fully bushed brake rigging would be much in excess of the present generally used un-bushed design. However, when taking into consideration the large amount of blacksmith shop work required to restore, and in many cases, renew the various parts of the rigging at the time of shopping it would appear to be a self-evident fact that the additional original cost would soon resolve itself into a large economy during the whole life of the locomotive. The mechanical staff of one of the prominent Western roads has recently recommended that on all new power the brake rigging be fully bushed. Without doubt the maintenance cost of the rigging thus designed will be greatly reduced below their present costs.

What has been said regarding pins and bushings in the brake rigging applies with equal force to spring rigging. We also find very few, if any, spring riggings and brake riggings put up with or arranged for any lubricating facilities at the bearings. Apparently it seems to be a prevalent idea that spring and brake rigging bearings can and should go without oiling. On the other hand a roundhouse man who systematically oils these parts as best he can, knows from the practical results obtained, that he is saving considerable labor and material. A single trial of oiling the spring rigging will invariably convince the most skeptical that there is a large shop economy in the plan, and also an easier riding engine. If all the larger bearings, at least, were originally equipped with simple oiling facilities, a considerable economy in wear would be expected.

On a great many roads it has been found to be a very desirable practice to change driving tires for re-turning instead of dropping the wheels and turning the tires on the original centers. Where such a practice is in vogue, particular attention should be given to the necessary clearance around and in front of the wheel centers, to permit tires to be heated and removed with the minimum amount of stripping of other parts of the locomotive.

Our attention was recently called to a type of six coupled engine in which, as was to be expected, the front drivers were located partly behind the guides and on which it was found necessary to remove the guides in part or as a unit, to change these front driving tires. All the additional clearance needed to have been able to do this work without disturbing the guides in any way, was about one-quarter of an inch. Apparently in the designing of the locomotive this maintenance feature was not taken into account as this desired extra clearance could readily have been obtained originally the same as it was later on. The comments on this particular detail on the part of the roundhouse foreman were more forceful than elegant, and if the locomotive builders had heard his momentary opinion of their ability as designers, I feel sure this little extra clearance would have been allowed, and possibly a little more.

On any line where there are a large number of curves, and frequently the combined feature of grades, the matter of lateral wear of engine and trailer truck wheels and drivers is of great importance. As the amount of pressure per square inch is the principal controlling factor in the wear of the parts in contact, it is readily appreciated that up to a reasonable limit, as large a hub face and box face as possible is a very desirable detail. As an example of following old proportions, I have in mind an engine truck detail where a box with a fourteen-inch over all width dimension is used. The axle has a six-inch wheel fit, and the wheel has an over all hub face diameter of eleven inches. The natural result of wear is that the eleven-inch hub bores a hole into the face of the box and the box usually comes into the shop as scrap. The ordinary short life of this hub and the box could very easily be extended considerably if the wheel hub face was made fourteen-inch diameter, and thus get the full benefit of the entire face of the box as it now exists, increasing the bearing surface fully 100 per cent. In addition to this there are the four corners of the box which would receive no wear and which could be brought into play by a hub or wearing plate, even larger than fourteen-inch diameter.

There are numerous cases of where this feature is fully appreciated and taken care of by large wheel hubs or wearing plates. In one instance, sixteen inches is used as a minimum hub face diameter instead of a maximum as is frequently the case.

The recommended practices of the American Railway Master Mechanics' Association on this detail, have taken into some consideration the hub bearing face when they present optional hub face diameters of 13½ to 15 inches.

In the case of the trailer trucks, the designer is not limited by any recommended or standard practices and can readily give full consideration to the subject of lateral wear. With the prevailing tendency, however, to reduce weight of steel castings, the hub face has usually come as a second consideration. Naturally, the strength of the hub to safely withstand the axle pressure fit, is the primary consideration, and as a result, the hub face has been usually taken as a sequence to that consideration instead of being one of the primary details. A hub face on a trailer that is small will, the same as with engine truck wheels, result in excessive lateral wear in a very short time. In some instances under local conditions this lateral will require attention as often as once in six weeks or two months' time, whereas six months would not be unreasonable to expect the locomotive to run without developing excessive lateral. At one time my attention was called to a design, which, when new, had about one hundred square inches bearing surface between the hub and box faces. A repair liner had been arranged for the face of the box, which was even smaller than the original face, and therefore reduced this area considerably By enlarging the hub diameter some three inches, using a plate for the purpose, the lateral bearing area was increased fully thirty-three per cent. Later, by making some slight alterations in the box design, a bearing area fully 100 per cent greater than the original, was found to be possible.

In addition to the consideration of bearing area in lateral detail, there is the subject of readily maintaining this lateral within the desired limits, without sending the engine to the back shop. Removable or adjustable hub liners and box face liners for engine and trailer truck wheels and for drivers have been schemed out with apparently indifferent success. In too many instances the poor results obtained were due to the impractically light construction of the parts, which soon broke, in service, and were lost out, making the resulting condition worse than the one which it was endeavoring to correct. A substantial liner, easily and firmly secured in place and capable of being prepared in advance to the proper thickness to take up lateral wear, can no doubt be adapted to all older power, as well as new power, providing the roundhouse man will make his wants known in a convincing way to the proper person.

With all the driving axles on the modern outside valve geared engines free of obstructions between the frame, there is a strong reason for considering having the driving box brasses held in position by keys or locks, rather than a pressed fit, so that new brasses can be applied to the boxes in the roundhouse, without dropping the wheels or sending the engine to the shops. For other than main driers, some roads are reported as having fitted up the brasses for rolling action only, using a slip brass with a crown fit of somewhat of the same type as the usual engine truck box brass. With generous main brass bearing and sufficient shoe and wedge surface, this plan would appear to be a perfectly reasonable one and worthy of careful consideration. Knowing as we do that with the main boxes and brasses closely lined up the other driving boxes and brasses can and should run with the wedges down somewhat and the journal brass fit a little loose, would it not be reasonable to start out with a design to suit that condition?

Few roads are retaining strap ended side rods, which were considered at one time an absolute necessity. The expensive and extensive strap and brass fits are now generally done away with and simple bushings used instead, particularly on both pairs of four coupled locomotives and all but the main pins of multiple

coupled locomotives. Some roads even find it desirable and advantageous to use a bushing for this main pin also.

Working along this same line, we find solid end main rods meeting with favor, where tried. The elimination of the strap bolts is no small gain to the roundhouse man and "file main rod brasses" does not mean so much of a job for him, as it did when he had to knock out a lot of strap bolts, possibly destroying one or more in the operation and at all times very uncertain as to when he could expect the job to be done. Instead of letting it go another trip because he was particularly rushed that day with work and did not want to get tied up on a hard job he now cleans it up when first reported.

"Examine packing, both sides blow," means a lot of work just to find that lubrication was not good or some other minor defect and not broken or worn out packing rings was the trouble. A lengthening of the piston rod enough so that the piston head would come outside the front end of the cylinder without disconnecting the pistons and cross head fit, would help materially in such work as much as possible. Theoretically, the slightly shorter main rod resulting would cause bad steam distribution, but practically such a result would be hard to find. Any coal lost, due to poor steam distribution as shown on paper, will be more than saved in better packing conditions as the result of the ease with which it can be examined.

Another feature of the piston rod and head detail is the use of a built-up type of head in which a bull ring is arranged that can be renewed to suit the wear or re-boring of the cylinder without the necessity of applying a new piston head and disturbing the piston and head fit. The roundhouse can thus readily keep the piston head true to the cylinder with minimum expenditure of time and labor. As the snap ring or any other type of cylinder packing can be adapted to this arrangement, it is readily suited to the requirements and views of practically all designers.

Where the eccentric and straps of the Stevenson link motion are still in use, a liner of brass or special wearing metal for the strap means a whole lot of time saved in curing a "lame" engine. These liners, when kept in stock all turned and bored for a quick application, assist the roundhouse man materially in overcoming lost motion and keeping the locomotive square.

The bearing surfaces of cross heads are ordinarily made of such a shape and secured in such a way that the taking up of the wear usually means dismantling the cross head or disturbing the guides. The latter is a prolific cause of resultant piston packing troubles, in that the guides are not always again set up true to the cylinders. Being out of line they cause the cross head and piston to run out of line also, and therefore the packing does not have a fair chance to perform its special duty. When the cross head is dismantled there are the usual number of fitted bolts to be loosened, with the customary result that one or more of them is damaged to such an extent that it cannot be used again. Often most of them will not have the proper draw when tried again and the result is a full or nearly full set of new bolts to be made.

With the numerous examples of substantial cross heads used in stationary practice that have ready and practical means of adjustment for wear, it would seem as though our locomotive practice should develop a scheme for taking up the cross head wear that would be practical and satisfactory. There is no doubt but that the general adoption of some such scheme would save lots of roundhouse labor and overcome very many of the annoying steam leaks in the piston packing.

With the general introduction of the fire tube type of locomotive superheater and its special flues of large diameter, there is a practice developing almost universally of welding these tubes into the back flue sheet. The uniformly satisfactory results lead one to question whether such a practice should not be as satisfactory for the small fire tubes of the boiler. For any part of the country where the water is of the quality known as "good"—that is, where there is no accumulation of scale on the flues or deposit of mud or sludge in the boiler, there is no doubt but that the welding of all of the flues into the flue sheet would be entirely successful, if tried. Most of us, however, are not blessed with such ideal conditions. The water we are using is generally heavily charged with incrusting solids and has large amounts of mud in it, which form deposits on the flues and at the usually most inaccessible points of the boiler. At the same time we are laying out our flue sheets with the flues staggered the same as we did years ago, with the fond idea that it is the most efficient plan for permitting the generated steam to rise through the water with the least amount of resistance. Should we not, on the other hand, lay out these flues with the principal thought in mind, as to how the boiler washer could get at each flue and get the scales down and out without forming a bank? Such a situation existed in connection with some stationary pumping boilers of the vertical type. The flues were spaced to put the largest possible number in the boiler. Invariably the central flues and the center of the bottom flue sheet would burn out in a very short time, due to a heavy accumulation of scale which could not be reached through any of the washout holes by a stream of water or by the hooks. A new layout of flues was tried in which there was a clear way for the washout nozzle from each washout plug hole to the center of the boiler; the flues were laid out so that a right angled nozzle would throw a stream between each row of flues to the shell of the boiler. As a result the boilers stayed in regular service almost indefinitely, the flue sheets and flues were cleaned and pumpers' steam troubles almost ceased.

With the information given us in a full authoritative manner that the flue heating surface is of secondary importance to the fire box heating surface, should we not take more thoughtfully in consideration the matter of facility in washing out when laying out our flues? And can we not in locomotive practice get the results our stationary boiler friend so easily obtained?

We cannot but believe that if considerable care and attention is given in advance to the details connected with the several parts of the locomotive that usually wear out of shape and proportion, there will be large returns in the lessening of delays incident to the making of repairs. And it is with such a thought uppermost in mind that we have presented these few items, trusting that the idea will mature and bring results to all of our roundhouse men along these and many other lines that may come to mind.

THE EXCEPTIONAL EMPLOYE.

The exceptional employe is the one who looks upon his employer's interest as he would his own, who regards his vocation as an opportunity to make a man of himself, to show his employer the stuff he is made of, and who is always preparing himself to fill a still higher position.

The exceptional employe is the one who never says, "I was not paid to do that;" "I don't get salary enough to work after hours or to take so much pains." He never leaves things half done, but does things to a finish. The exceptional employe is the one who studies his employer's business, who reads his literature, who is always on the watch for every improvement which others in the same line have adopted and which his employer has not; who is constantly improving himself during his spare time for a higher position with more responsibilities and a larger salary.

When your employer finds that you have lots of enterprise, that you are trying to learn as much about his business as he knows himself, he will begin to think that you are made of promotion material. But if he see that your ambition is just to get your salary and have as easy a time as you can, you will never attract his attention, except for a possible blacklist. An employer wants no dead wood around him; he wants live wires. He wants employes who have ambition enough to be willing to pay the price for promotion. If you want to be something more than the average worker you must do something more than average work.

The Pennsylvania has placed a contract with L. H. Focht & Son, Reading, Pa., for a double track, ten arch concrete bridge over the Schuylkill river at Phoenixville, Pa. The new structure will cost about $300,000.

CONSERVATION OF OUR CAR SUPPLY.*

By J. R. Kearney, Supt. of Trans., B. & O. R. R.

It is a tendency of human nature when trouble arises to blame it on the "other fellow." In the case of car shortage the "other fellow" is the public. I am firmly convinced, however, that the trouble in this case does not entirely lie with the public, but that the remedy lies in another direction.

While there is no data regularly compiled to show delay to cars by consignees except at tidewater and lake piers, I believe shippers generally are handling cars promptly. The cars that are delayed by the public are pretty well covered by demurrage regulations that are generally enforced.

A number of larger shippers are writing to their consignees urging them to order full carloads, to release cars promptly in order to conserve car supply.

Cars placed for loading coal, coke, ore, limestone, etc., which comprise over half the loading in the Baltimore & Ohio, are all practically loaded out and ready for movement the same day as placed; many of them within a few hours after being placed. L. C. L. cars, which are also a goodly number, are of necessity loaded promptly.

I do not think much more can be accomplished with the shippers, but that an effort must be made to reduce the railroad detention. Such delays are absolutely under our control. We do not need to go to the Interstate Commerce Commission to secure authority to file tariffs covering such delays. I am firmly convinced that the delays are in our terminals. Perhaps you may say that cars are being moved promptly. How do you know? Who knows what is the average yard delay? Is there a superintendent here who can say what is the average delay to cars in yards on his division?

An audit has been made on the delays in several yards. At one point the average delay to loads in transit; that is, loads passing through the yards, is about twenty-four hours, a per diem tax of forty-five cents per day on every car through that yard. In another yard the average delay is thirty-one hours or a per diem tax of about fifty-five cents per car. It is a significant fact that in another yard where this audit has been made and where the delay has been steadily reduced, during the past two weeks, while the average miles per day on the system generally decreased, the average on the division where that yard is located increased. In another yard a special check was made of the railroad detention; that is, the time between the arrival of the car in the yard and placing it for the consignee to unload. The average was forty hours. In addition to this, there is a delay of which no record is kept covering time between the release of the car and forwarding, which at a low estimate will average eight hours, so that the railroad detention to cars placed for loading and unloading in that yard is at least forty-eight hours.

At Lorain, the port where we unloaded over 14,000 cars of coal last month, the railroad detention for several months past has been higher than the consignees' detention. In this case the consignees' detention is computed from the time the cars arrive until their vessel reports; the railroad detention is computed from the time the vessel reports for cargo until the cars are dumped into the vessel.

The consignees' average detention on the railroad is not forty-eight hours. If it were there would be a very large amount of demurrage collected.

I do not think that any of us fully realize the amount paid for hire of equipment, nor the cost of slow movement. Among the most expensive things on the railroad are delayed and diverted cars. The hire of equipment is not charged against operating expenses, and is therefore possibly not brought so forcibly to the attention of the division officers as it otherwise would be.

Last year there was paid for per diem on foreign cars $5,293,537; for mileage $609,352, a total of $5,902,889. This is exclusive of reclaims.

* Extract from a paper in the Baltimore & Ohio Employes' Magazine.

The total debit charge for hire of equipment account last year was $627,138.

The average miles per car per day for the past fiscal year were 26.2. If the average were increased to twenty-nine miles per day, or a little less than the best month's average last year (October, 1912, when we made 29.5 miles per day), we would have saved $1,358,676. If increased to thirty miles per day, the saving would be $1,789,175; to thirty-three miles per day, $2,924,471; to thirty-five miles per day, $3,567,510.

It is a noticeable fact that in October last (1912) the numbers of cars on line was the lowest, the average miles per car per day, and the percentage of loaded mileage and freight earnings the highest during the year. The earnings went over $300,000 in excess of May, when we had 18,000 more cars on line than in October.

The October performance is an illustration of what can be done through prompt movement; also that it is possible to handle the traffic with a much smaller number of cars than we now have on line.

The average earnings per loaded car mile were 14.8 cents in October, 1912, and July, 1913. In October, with 77,496 cars, the freight tonnage revenue was $7,471,501; in July, with 92,769 cars, earnings were $6,838,746; that is, with a little over 15,000 more cars on line in July than in October the earnings were $633,000 less. The figures just quoted show the savings that can be made in per diem by quickening the car movement.

Looking at the question from another angle, we find that in quickening car movement the value of the car day increases. The average earnings per car per day last year were $2.52, or 9.6 cents per mile. If the mileage were increased to thirty-five miles per day the value of the car day would be increased 84 cents, or $3.36 per day; if increased to a little over thirty miles per day, the value of a car would be $3.00 per day. If thirty miles per day had been made last year it would have given us the use of 10,893 more cars daily, which if needed to handle traffic and not sent home to save per diem, would have enabled the road to have increased its earnings very largely.

Among the things that are responsible for increasing expense and reducing average mileage is the delay in repairing bad order cars. Last year the average number of bad order cars was 5,319. If the average had been kept to 4,000, it would have given us the use of 1,319 cars and saved $216,645 in per diem. At the present time there are about 8,300 bad order cars. The excess of 4,300 is costing us at the rate of $58,050 per month, or nearly $700,000 per year.

Bad order cars should be repaired promptly, both loaded and empty, system and foreign. The delay to a bad order load means delay in delivery of shipment and possible complaint from shippers; in case of loaded and empties, a per diem charge of forty-five cents, as when a foreign car is delayed, per diem is paid on it to the owner and when a system car is delayed, a foreign car is usually used to take care of the shipment which could have been handled with the system car.

There is nothing gained by delaying the repair of bad order cars. Repairs must be made sooner or later. In some cases traffic is lost on account of cars being delayed in transit while awaiting repairs. In addition, when bad order cars accumlate so that the repair tracks will not hold them, it is necessary to repair them in other parts of the yard, in many cases congesting yards, interfering with switching and increasing switching expenses, also preventing movable cars being handled in their turn.

The American Railway Association has formulated a set of rules for handling foreign cars, which are known as car service rules 1 to 4, inclusive. These rules are very broad, and with the diversified loading on the Baltimore & Ohio, we should be able to load foreign cars home or to home route junction points. In order to do this, we should solicit the aid of shippers by having them specify destination in ordering cars. Aside from the question of rules, it is good policy on the part of the Baltimore & Ohio to handle foreign cars properly. It is an originating line and is dependent upon return of its cars from foreign lines in order to handle

traffic. If we do not handle foreign cars properly we are not in a position to demand proper handling of the Baltimore & Ohio cars by other lines.

A home route card, Form 229 M. T., has been provided in order to secure the proper routing of cars, and in order to avoid delay in securing proper routes. A number of yards, however, are not forwarding these cards with cars. This is increasing per diem expense, on account of cars having to be held until routes can be secured. A number of foreign cars have been handled over the road during the past year on bogus or incorrect cards. It is difficult to determine what it has cost the Baltimore & Ohio due to this practice.

Many foreign cars are received from connections in switching service on which we receive a reclaim. The reclaim allowance is generally four days, although at some large terminals five days is allowed. This reclaim allowance is fixed by the roads in each terminal. We should make special efforts to handle the cars delivered to us for switching as quickly as possible, as every car returned in less than the reclaim period means that much per diem saved.

Last year the amount paid for switching reclaims was $981,585; for special reclaims, mostly on cars not received from connections promptly, $23,585; a total of $1,005,170. Amounts received, switching reclaims, $370,434; special reclaims, $22,968; total, $393,402; total debit balance, $611,768.

The balance this year will be heavier on account of increased rate, and the large number of cars that we have not received from connections promptly. Special efforts should be made to accept all cars from connection promptly in order to keep down these reclaims, and cars for consignees on our tracks should be placed under demurrage regulations as promptly as possible.

CAR DEPARTMENT STATISTICS, N. Y. C. & H. R.

The following is from a statement prepared by F. W. Brazier, superintendent of rolling stock of the New York Central & Hudson River, showing a few car department details on that road for the year 1913. The months of November and December are estimated.

Freight Cars Repaired.

	Light.	Medium.	Heavy.	Total.
N. Y. C. cars	906,158	12,624	17,430	936,212
Foreign cars	1,697,270	14,553	5,969	1,717,792
Total	2,603,428	27,177	23,399	2,654,004
Contract Shop	153	1	2,894	3,048
Grand total	2,603,581	27,178	26,293	2,657,052

Number of pasenger cars repaired	76,886
Passenger cars owned, including electric cars	2,181
Number of freight cars owned	76,850
Number of repair yards	62
Number of repair shops	16
Number of men	7,225
Amount of pay roll	$ 5,000,000
Total labor and material approximated	$14,000,000

WHY HE KEPT HIS JOB.

One of the bosses at Baldwin's Locomotive Works had to lay off an argumentative Irishman named Pat, so he saved discussion by putting the discharge in writing. The next day Pat was missing, but a week later the boss was passing through the shop and he saw him again at his lathe. Going up to the Irishman he demanded, fiercely:

"Didn't you get my letter?"

"Yis, sir, Oi did," said Pat.

"Did you read it?"

"Sure sir, Oi read it inside and Oi read it outside," said Pat, "and on the inside yez said I was fired and on the outside yez said, 'Return to Baldwin's Locomtive Works in five days.' And here I am."—*Lippincott's.*

PACIFIC SHOPS OF THE PANAMA CANAL.

By E. H. Davidson.

The designing work in connection with the permanent shops at the Pacific terminal of the Panama canal and the inspection of erecting the steel work and roofing has been under the immediate direction of Lieut. Col. T. C. Dickson, Ordnance Department, United States Army. The steel framework for the shop buildings amounting to about 6,000 tons was furnished and erected by the United States Steel Products Co.

The foundation for the shops with the exception of a few carried to solid rock, rest on clusters of timber piles, about ten piles to the cluster, driven to a depth of about 35 feet and spreading over a circular area of about 30 feet in diameter. The heavier superstructures for the wharf facilities and the coal plant will rest on caissons driven to rock at a general level of about 50 feet below sea level.

Most of the caissons will be of 6-foot reinforced concrete, and the others will be 4 to 6-foot diameter steel shells similarly filled.

The buildings in general are of the usual mill building type of construction with steel framework. The general design provides heavy columns of steel around the exterior walls supporting the truss work of the roof and leaving the interior unobstructed.

The pattern storage and the roundhouse have flat roofs of reinforced concrete, covered with composition roofing supported on channel purlins and I-beam rafters. The other buildings have double pitched roofs, with a pitch of one-fourth, supported on channel purlins resting on the roof trusses, which are carried by the columns. The concrete tiles, the majority of which measure 2 by 4 feet each, rest directly on the channel purlins. Light is admitted through the roofs by means of heavy wired glass set in some of the tiles. The main roof spans are in general 43 feet high. In the construction of the car shop, planing mill and lumber and equipment shed two such spans of 61 feet 2 inches were placed side by side.

The sides and ends of the machine shop, forge shop, boiler shop, planing mill and foundry—except at the crane openings in the ends, which will be closed with steel rolling doors—will be enclosed by 8-inch concrete walls to a height of approximately 3 feet 3 inches above the floor level, and above the walls will be placed moveable metal louvres which will extend to the eaves of the lean-tos. The steel storage shed will be entirely enclosed with rolling steel doors, except the gables will be closed with cement plaster on metal lath. The walls for the office, general store house, pattern storage, paint house and toilets are made of hollow tile plastered on both sides; those for the paint shop, galvanizing plant and coke shed are of more solid concrete 5 inches thick. The flooring of the various buildings is of material best suited to the requirements of the work performed in them. In the machine shop and planing mill where machine work is to be performed the floors will be of wood blocks laid on concrete.

To permit convenient access at all times and to prevent cutting into the floors of the buildings and the pavements outside an underground tunnel having a clear height of 6 feet and width of 4 feet 6 inches, and with branches of same height and a width of 3 feet 6 inches, is constructed of reinforced concrete to connect with the principal buildings and the substation and air compressor plant. This tunnel will contain all power, light, telephone, firm alarm cables, water, steam, fuel oil, compressed air mains and the main sewer. Rain water will be carried off the area occupied by the shop buildings by means of surface gutters and drains.

Crane runways for heavy overhead electric traveling cranes have been provided to extend the length of the machine shop, erecting shop, forge shop, steel storage shed, boiler and shipfitter shop and 38 feet 5 inches beyond either end, so the cranes can serve the double tracks along each end of the buildings. In the foundry the craneway extends the length of the building and 105 feet 5 inches beyond the west end over the flask yard. The galvanizing plant has a craneway extending the length of the building.

The machines installed or to be installed at the terminals are of the type usually found in manufacturing, marine and railway shops, but the assembling of so many different classes and types in one plant makes a combination of equipment that can probably be found nowhere else in the world.

The facilities at Balboa are designed to manufacture and make repairs for railroad equipment and such general work as will be carried on along the canal: To make repairs to the operating machinery of the locks, spillways, dams, lock gates; to maintain the permanent dredging equipment on the canal, and to repair the vessels of the United States Navy, and also vessels engaged in commercial service.

RAILWAY LESSONS FOR MARCH, I. C. S.

The railway department of the International Correspondence Schools, Scranton, Pa., reports the following lessons passed during March, 1914:

Railway.	Number of Lessons
Algoma Central & Hudson Bay	10
Atchison, Topeka & Santa Fe	96
Atchison, Topeka & Santa Fe, Coast Lines	15
Atlanta, Birmingham & Atlantic	16
Baltimore & Ohio, Chicago Terminal	9
Baltimore & Ohio Southwestern	27
Bangor & Aroostook	5
Boston & Maine	64
British Columbia Electric	6
Buffalo, Rochester & Pittsburgh	33
Canadian Northern	45
Canadian Northern Ontario	15
Canadian Pacific, Lines East	190
Canadian Pacific, Lines West	82
Carolina, Clinchfield & Ohio	6
Chesapeake & Ohio	184
Chicago & Alton	10
Chicago & Western Indiana	17
Chicago, St. Paul, Minneapolis & Omaha	14
Chino Copper Co	10
Cincinnati, Hamilton & Dayton	20
Coal & Coke	29
Crossett Lumber Company	15
Delaware, Lackawanna & Western	40
Denver & Rio Grande	63
Duluth, South Shore & Atlantic	7
El Paso & Southwestern System	21
Florida East Coast	7
Great Southern Lumber Company	5
Gulf, Colorado & Santa Fe	16
Kansas City Southern	9
Kentucky & Indiana Terminal	8
Louisiana & North West	8
Maine Central	19
Minneapolis, St. Paul & Sault Ste. Marie	18
Missouri, Kansas & Texas	23
Missouri Pacific System	55
Mobile & Ohio	19
Oregon Short Line	38
Oregon Washington R. R. & Navigation Company	21
Pere Marquette	18
Pittsburgh, Shawmut & Northern	7
Seaboard Air Line	6
Southern Railway	63
Spokane, Portland & Seattle	8
Sunset Central Lines	89
Toronto, Hamilton & Buffalo	12
Tremont Lumber Company	13
Western Maryland	106
Total	1,617
Average Number	33

ARTICULATED COMPOUND LOCOMOTIVE, ERIE R. R.

The Erie has recently received from the Baldwin Locomotive Works a locomotive for pusher service, which develops a tractive force of 160,000 pounds, and is by far the most powerful unit yet built. This capacity is secured, not by using excessive wheel-loads or a rigid wheel-base of unusual length, but by placing driving-wheels under the tender and thus making the weight of the latter available for adhesion. In heavy grade work especially, the weight of the tender detracts materially from the net hauling capacity of a locomotive of the usual type; while in this case, the tender is used as a means for increasing the hauling capacity.

This locomotive is built in accordance with patents granted to George R. Henderson, consulting engineer of The Baldwin Locomotive Works. The wheel arrangement is 2-8-8-8-2, the third group of driving-wheels and the rear truck being placed under the tender section. The cylinders are all of the same size, two acting as high pressure and four as low pressure. The two high pressure cylinders drive the middle group of wheels. The right-hand high-pressure cylinder exhausts into the two front cylinders and the left-hand high pressure cylinder exhausts into the two rear cylinders. This arrangement is, therefore, equivalent to a compound engine having a ratio of cylinder volumes of one to two.

The boiler has a conical connection in the middle of the barrel, and is fitted with the Gaines type of furnace. The firebox has a total length of 13′ 6″, and of this the grates occupy 10 feet. A combustion chamber 54″ long extends forward into the boiler barrel, and the tubes have a length of 24′ 0″. The brick arch is supported on six 3½″ tubes; and heated air is delivered under the arch by seven 3″ pipes which are placed vertically in the bridge wall. There are two fire-doors, placed 32½″ between centers; and a Street mechanical stoker is applied.

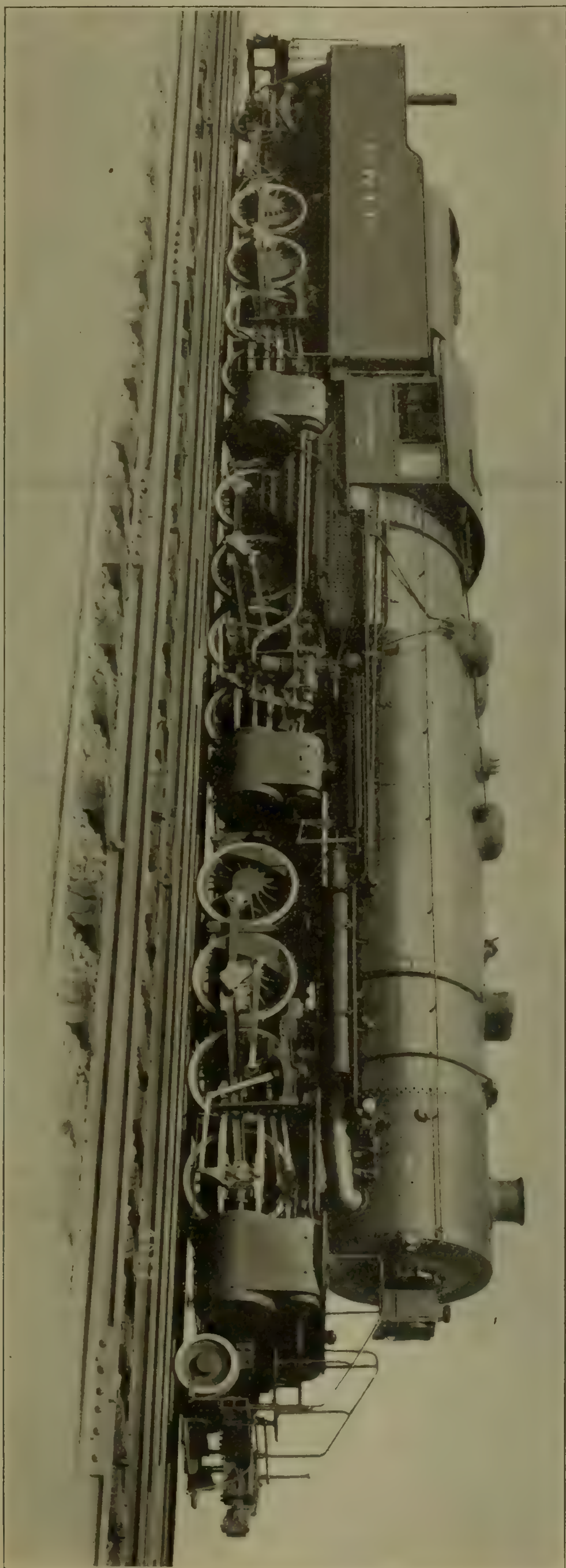
The barrel of this boiler measures 94″ in diameter at the front end and 108⅛″ at the dome ring. The center line is placed 10′ 7″ above the rail. The circumferential seams are triple riveted, while the longitudinal seams have sextuple riveted butt joints, which are welded at the ends, and have an efficiency equal to 90 per cent of the solid plate. The dome is of pressed steel 33 inches in diameter and 13″ high. It contains a Chambers throttle, which is connected with the superheater header, in the usual manner, by an internal dry pipe. The superheater is composed of 53 elements and is the largest ever applied to a locomotive; the superheating surface being 1,584 square feet. The header is divided, separate castings being used for the saturated and superheated steam sections. The front end contains a single exhaust nozzle, with ring blower. The size of the nozzle can be varied by a simple adjusting device placed outside the smoke box. The stack is 22″ in diameter, and it has an internal section which extends down to the center line of the boiler.

The superheated steam is conveyed to the high-pressure cylinders through outside pipes, and the high-pressure distribution is controlled by 16-inch piston valves, arranged for inside admission. Similar valves are applied to the low-pressure cylinders. These valves are all driven by Baker gear, and the three sets of motions are controlled simultaneously by the Ragonnet power reverse mechanism. All six cylinders are cast from the same pattern, and the valve motion and driving gear details used with the three groups of wheels are as far as possible interchangeable. A large number of these details also interchange with those of the heavy Mikado type locomotive in service on this road.

Among the details of the driving gear may be mentioned the pistons, all six of which are alike. The piston heads are steel forgings, of dished shape; and each is surrounded by a cast iron bull ring. The bull ring carries three packing rings, and is secured to the piston head by a retaining ring which is electrically welded into place. The cylinders and steam chests are bushed; and these bushings, as well as the piston and valve packing rings, are of Hunt-Spiller metal.

The pipes connecting the high and low-pressure cylinders are constructed like the flexible pipes in a Mallet locomotive. The high pressure cylinder saddle has cored in it two passages, one of which conveys the exhaust from the right-hand cylinder to the

front receiver pipe, while the other conveys the exhaust from the left-hand cylinder to the back receiver pipe. The front cylinders exhaust up the stack in the usual manner, while the exhaust from the rear cylinders is discharged up a pipe placed at the back end of the tank. Between the rear cylinders and the exhaust pipe is placed a feed-water heater, through which the exhaust steam passes. The heater consists of a long drum, traversed by small tubes. The drum has connection with the tank through a suitable valve, and the exhaust steam passes through the tubes. The hot feed from the drum is forced into the boiler by two pumps, which are driven from the crossheads of the high-pressure engine. Two injectors are also used, and they draw cold feed-water from the front end of the tank. The pump and injector checks are placed on the top center line of the boiler near the front end.



Articulated Locomotive for Pusher Service, Erie R. R.

The tender section, as far as frames, wheels, equalization and driving gear are concerned, is arranged like a steam locomotive. The tank is supported on the frames by six bearers, which serve as transverse frame braces also. Three of these braces are placed between adjacent pairs of driving-wheels; one is placed just back of the rear driving-wheels, one above the rear truck, and one under the back end of the tank. The width of the tank is 10 feet 8 inches, and it is placed sufficiently high to clear the valve motion.

The articulated connection between the middle and rear frames is placed under the cab, and between the rear cylinders. The radius bar on the middle frames makes a ball-jointed connection with the hinge-pin. A similar connection is provided between the middle and front frames, and in this case the radius bar is pinned to the front frames in such a way as to allow vertical flexibility.

The frames are of vanadium steel castings, 6 inches in width. Each is made in one piece with a single front section, to which the cylinders and saddle are keyed and bolted. The front group of wheels is arranged with a continuous equalization system, the leading truck being center bearing and equalized with the driving wheels as in a consolidation engine. The second group of wheels has a continuous equalization system on each side of the locomotive. In the rear group the equalization is broken between the second and third pairs of driving-wheels. The rear truck, which is of the side bearing type with outside journals, is equalized with the two rear pairs of driving-wheels. The arrangement of starting valve usually applied by the builders to Mallet locomotives is used on this engine; except that in the present case live steam is admitted to four low pressure cylinders instead of two. The admission of steam is controlled by a manually operated valve in the cab.

This locomotive marks an interesting step in the development of heavy power for freight service. The efficiency of a locomotive for slow, heavy work, is measured largely by the proportion of the total weight that is available for adhesion, and in this respect the present locomotive excels, as about 90 per cent of the total weight is carried on the driving-wheels, as against approximately 65 per cent in a Mallet locomotive of the 2-8-8-2 type, including, in the latter case, the weight of the separate tender.

The principal dimensions are as follows:

Gauge .... 4′8½″

Cylinders.

High-pressure, two .... 36″ x 32″
Low-pressure, four .... 36″ x 32″
Valves .... Piston, 16″ diam.

Boiler.

Type .... Conical
Diameter .... 94″
Thickness of sheets .... $\frac{15}{16}$″ and 1″
Working pressure .... 210 lbs.
Fuel .... Coal
Staying .... Radial

Firebox.

Material .... Steel
Length .... 162″
Width .... 108″
Depth, front .... 87¼″
Depth, back .... 68″
Thickness of sheets, sides .... ⅜″
Thickness of sheets, back .... ⅜″

Thickness of sheets, crown	⅜"
Thickness of sheets, tube	⅝"
Water Space.	
Front	6"
Sides	5"
Back	5"
Tubes.	
Material	Steel
Diameter	5½" and 2¼"
Thickness	5½", No. 9 W. G.
Thickness	2¼", No. 11 W. G.
Number	5½", 53; 2¼", 326
Length	24' 0"
Heating Surface.	
Firebox	272 sq. ft.
Combustion chamber	108 sq. ft.
Tubes	6,418 sq. ft.
Firebrick tubes	88 sq. ft.
Total	6,886 sq. ft.
Grate area	90 sq. ft.
Driving Wheels.	
Diameter, outside	63"
Diameter, center	56"
Journals	11" x 13⅛"
Truck Wheels.	
Diameter, front	33½"
Journals	6" x 12"
Diameter, back	42"
Journals	9" x 14"
Wheel Base.	
Rigid, each group	16' 6"
Driving	71' 6"
Total	90' 0"
Tank.	
Water capacity	10,000 gals.
Coal capacity	16 tons
Weight.	
On all driving-wheels	753,600 lbs.
On truck, front	32,050 lbs.
On truck, back	59,400 lbs.
Total	845,050 lbs.
Service	Heavy pushing

Tender section driven by steam.

ELECTRIC TOWING LOCOMOTIVES, PANAMA LOCKS.

The first lot of electric towing locomotives for hauling vessels through the locks of the Panama Canal are now being received at the Isthmus. In all forty of these "electric mules" are being built by the General Electric Company for this purpose. The machines weight 82,500 lbs.; measure 32 ft. 2½ in. long by 8 ft. wide by 9 ft. 3 in., the greatest height over the cabs; have an available tractive effort as high as 47,500 lbs. and a windlass rope pull of 25,000 lbs. Four of them, two on each side, will ordinarily propel steamships through the locks. Sometimes six engines will be needed to handle extra large vessels; in every case two astern, acting as a brake on the ship's movements, will give direction to her course. No vessel will be allowed to enter the locks and go through on her own power.

The locomotive is built up of cast steel side and end frames, cross ties and bedplates. It is mounted on two axles with wheels in accordance with M. C. B. standards. The entire frame is supported from journal boxes of the regular railway type by means of coiled springs. The sides and top of the body are enclosed by sheet iron covers which fit in place and are very easily removable. At each end are enclosed cabs so that the locomotive may be operated from either end.

The locomotive is propelled by means of a rack rail while towing and while going up or down the steep grades from one level to another at a speed of 2 miles per hour. While running idle or on return tracks, the speed is changed to 5 miles per hour and the machine is propelled by the regular traction method, the rack pinion being entirely released. This change is effected by manually-operated clutches located in the gear mechanism in connection with a lever in each cab similar to a steam locomotive.

The locomotive is driven by two 75 h. p. totally enclosed motors of the mill type, one being direct connected through reduction gearing to each axle. Three phase, 25 cycle, 220 volt current is used and is collected by contact plows. The motor and traction gearing is mounted on a common baseplate, which in turn is mounted on a driving axle and spring suspended to the locomotive frame the same as in regular railway practice.

In the center of the locomotive is located a vertical windlass with drum, the capacity of which is 800 feet of 1-inch steel hawser cable. The windlass with its driving motors and gearing is mounted on a solid baseplate and is likewise independent of the movement of the locomotive frame. The cable drum extends above the locomotive cover and has a floating guard placed around it to retain the cable while coiling loose.

Electric Towing Locomotives for Panama.

The windlass cable is handled by two 20 h. p. motors, also totally enclosed and of the mill type. One is geared for a rope speed of 12 feet per minute at a pull up to 25,000 pounds at 2-foot radius, and its function is to adjust the position of the ship for anchor or while being towed through the locks. The other motor is geared for a rope speed of 200 feet per minute at 2-foot radius, and its duty is to take up slack or pay out cable or wind in any part of the entire length of cable as may be required. The cable drum is driven through a friction device which can be set at any desired value from zero to full capacity of the motor.

The traction motors as well as the windlass motors are controlled from either cab. In other words, the control equipment is duplicated. The traction motors are operated by one master controller and contractors forward and reverse; while the windlass motors are operated by a reversible drum controller, and the clutch on the main vertical shaft by a solenoid.

The executive committee of the Traveling Engineers' Association will meet during the later part of May to decide on the dates of the next meeting.

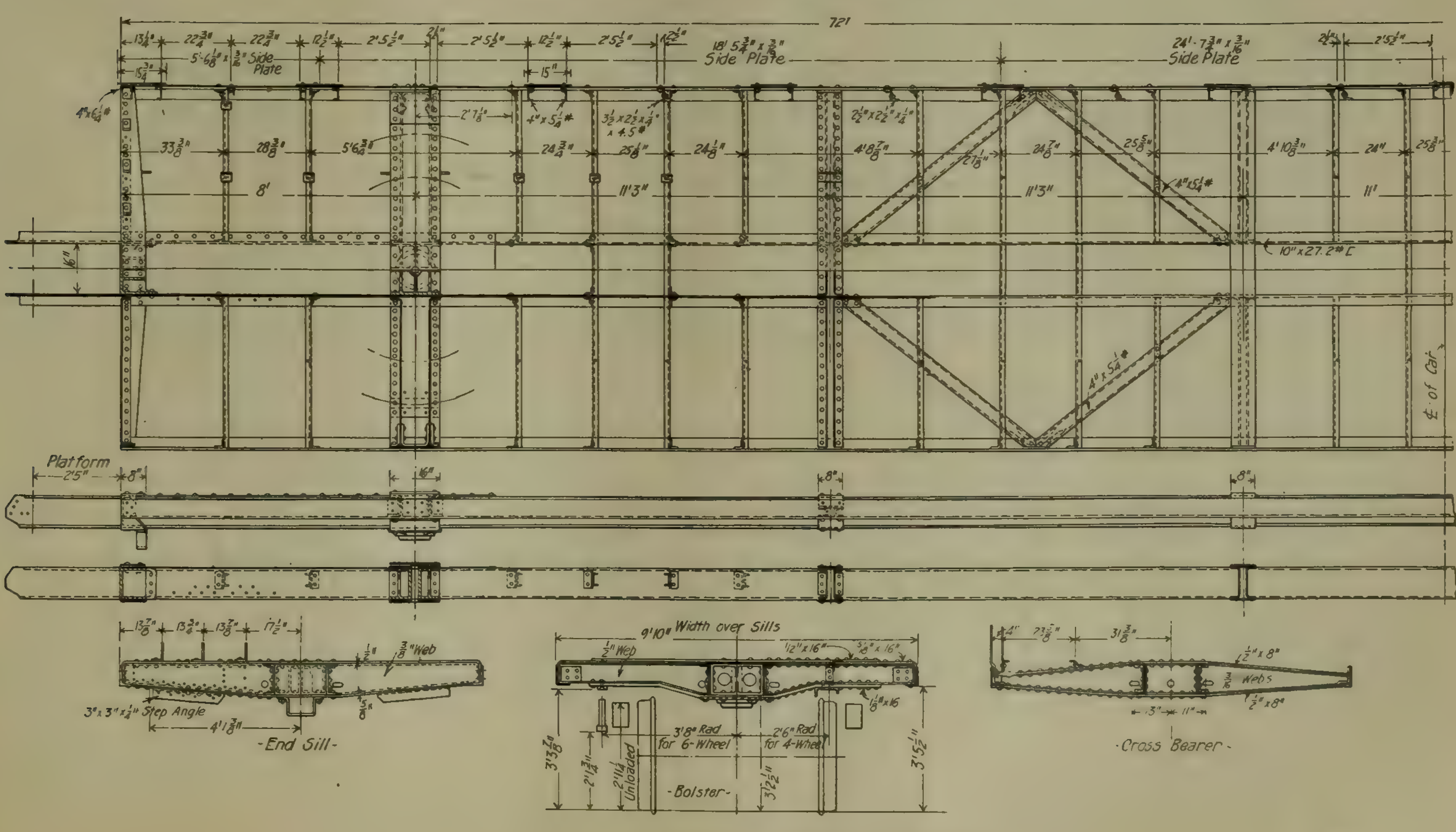
Steel Passenger Coaches, C. P. R.

The Canadian Pacific Raliway some time ago made careful tests comparing the steel coach with the standard wooden cars on trips between Montreal and Quebec in winter weather and it was clearly demonstrated that the steel car was equally comfortable, if not more so than the wooden car. This road is at present building thirty steel colonist cars, twenty-five 72 feet 8 inches steel first class coaches and twelve 70 feet steel baggage cars, at its Angus shops. The first class coaches are shown in the illustration and are of a modified turtle back type, with dormer windows, thus preserving the clere-story effect on the inside of the car. A number of this type has been in service for about two years.

The center sills are composed of two 10 inch, 27.2 lbs. channels which run from buffer to buffer and are tied together by the bolsters and four cross bearers. The web thickness of the bolsters is ½ inch and that of the cross bearers $\frac{3}{16}$ inch. The side sills are composed of 4 x 6 x ½ inch angles. The floor beams are 4 inch channels spaced about 2 feet apart. At each bolster there are two top cover plates ½ x ⅝ x 16 inch, and a bottom cover plate 1⅛ x 16 inch. The end sills are of ⅜ inch pressed steel with the flanges turned inwardly, with heavy castings between the center sills and end sills.

The main side posts consist of two 4 inch, 5¼ lb. channels and

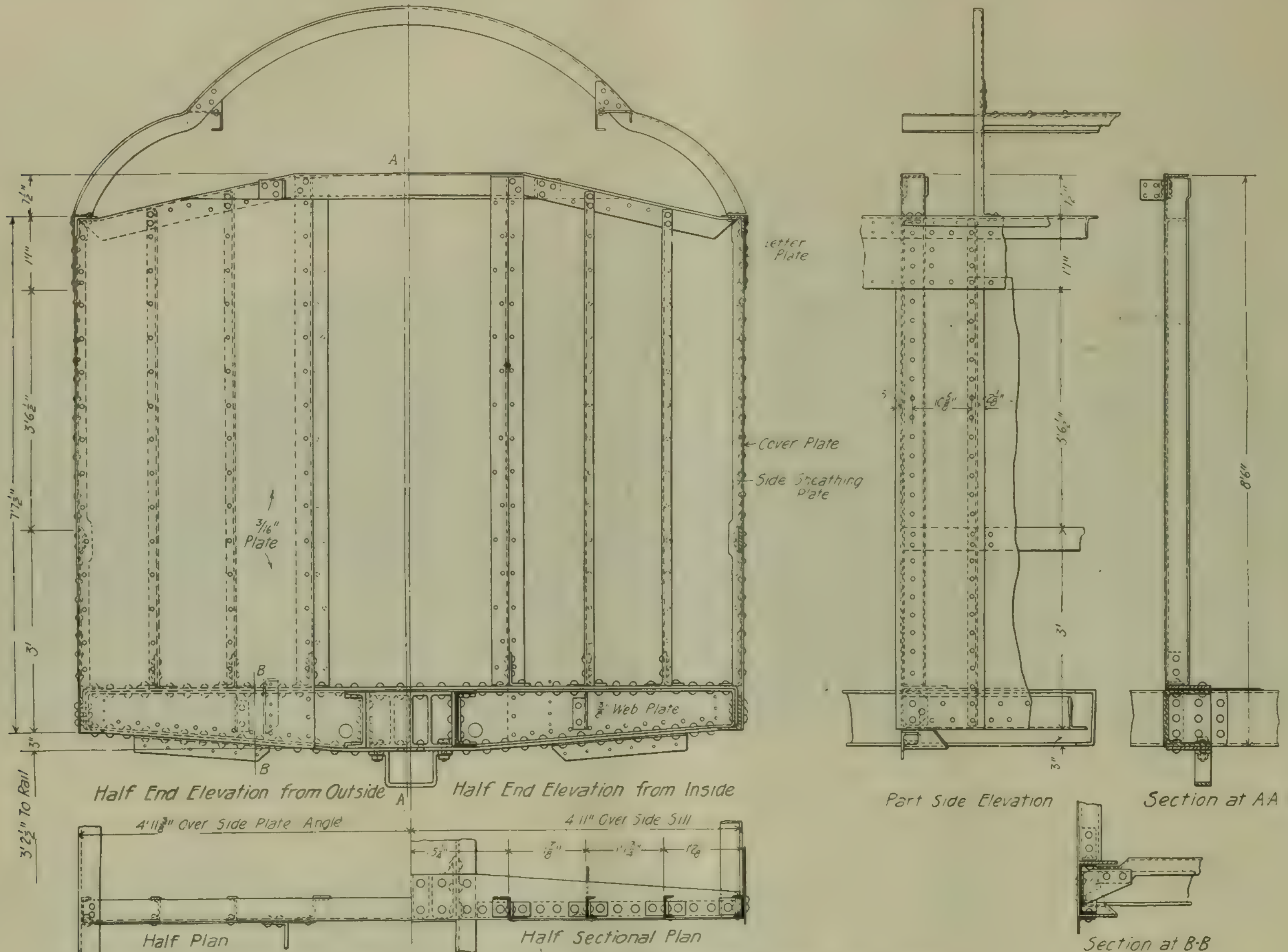
72 Foot Steel Coach. Canadian Pacific Ry.



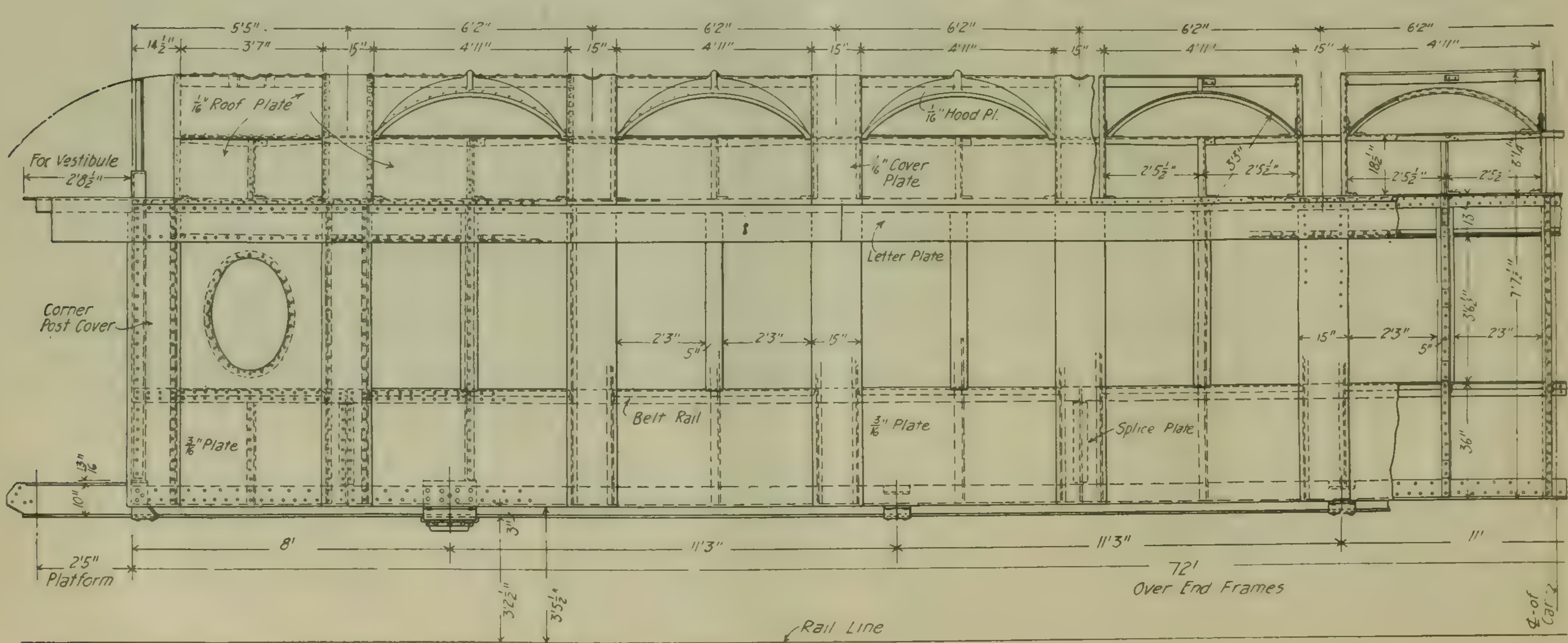
Plan of Underframe and Details. Canadian Pacific Steel Coach.

the intermediate posts are of $2\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{4}$ inch angles. A 4 x $\frac{1}{2}$ inch belt rail is set in recesses in the side posts and upon this rests the wooden window sills. Steel sheathing is used below the belt rail. The main carlines are of $3\frac{1}{4}$ x $1\frac{5}{8}$ x $\frac{3}{16}$ inch angles, conforming to the contour of the roof. Quarter inch pressed angles and $\frac{1}{8}$ inch channels are used in the deck construction. The roof sheets are of $\frac{1}{16}$ inch steel and deck sash casings are of $\frac{1}{8}$ inch pressed steel. The plates forming the sides of the steps are of $\frac{1}{8}$ inch steel, the treads and risers being pressed from No. 15 gauge steel and secured to the sides by $1\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{8}$ inch angles, welded to both sides and steps. Lead tread plates are used.

The body is mounted on four-wheel trucks and the car weighs 114,800 pounds. The insulation consists of 2-inch cork in the side walls, with 3-ply salamander under the floor and roof. The floor is of Keystone sheets and Plicaro cement, with $\frac{1}{2}$-inch compressed cork on top, the sub-floor being of No. 20 galvanized iron. The interior finish is mahogany, the panels being mahogany veneered steel sheets and the head lining of the center deck of Agasote. A solid mahogany color is given to the exterior in order to harmonize it with the natural wood mahogany sheathing. Side decks, end doors and steps are steel. Westinghouse LN air brakes are used, with cylinders and reservoirs suspended on the trucks. The cars are equipped with friction draft gear, long travel friction



End Framing and Details of Canadian Pacific Steel Coach



Elevation of Framing for Canadian Pacific Steel Coaches.

Interior of 72-Foot Steel Coach, C. P. R.

buffer, gas lighting, Frumveller heater and have a capacity of eighty-four passengers. The details are clearly shown in the illustrations.

LOYALTY.

Money makes the mare go—but it's loyalty that makes her want to go. Loyalty is the dynamic force that transforms an automaton into a man. It is one of the few things that money alone can't buy, but it is worth a fortune to both the organization and the individual. For without it team work is a barren ideality and success a mirage.

Grandstand players never produced a pennant winner, but second class men working in harmony, all pulling for a definite goal, have been known to bring home the bunting. It is the spirit of loyalty, the esprit de corps, that excludes selfishness, subjugates the ego and makes itself manifest in net results.

And all loyalty is based on confidence.

I once knew a salesman, and a good one, who had been nursing a fancied grievance against the manager for some time. The trouble wasn't apparent in his general attitude, but it showed up in his work. He started out one spring on a long trip and hadn't been out two days when he was shaken up pretty badly in a railroad mishap. The boss found out about it and took the first train to the small town where he found his man suffering painful, though not serious, injuries and getting only superficial attention. There wasn't a passenger train through that point for ten hours, so the manager made arrangements to charter a locomotive and cab and take the salesman to a larger town sixty miles down the road. When they arrived, he took him to the best hospital, secured a nurse and the services of the best doctor available. In a few days he was able to leave and continue his trip.

This manager was a wise man, for he had killed the seed of discontent and had engendered the spirit of loyalty. He had confidence in his salesman and he was loyal to him. From a viewpoint of dollars and cents he was repaid ten times for all the trouble and expense he had assumed. Men who don't know, can't see, and won't understand the benefits accruing from absolute loyalty to the boss and the organization, are already making a sprint for oblivion. They are strictly in class "B" and sooner or later Nemesis will call them for her own. Like a cancerous growth, the knife must be used to save the rest of the body from contamination.

Yes, money alone may make the mare go, but when the money falters the mare stops. With loyalty as the propelling force, she'll go till she drops in her tracks.—*Drill Chips.*

SAFEGUARDING RAILROAD SHOPS.

Louis Brentnall.

During the past few years operating officials have given special attention to the matter of safeguarding railroad property in order to prevent accidents and personal injuries, and as a consequence many casualties have doubtless been averted. Rolling stock which under ordinary conditions might have become damaged in an accident is still following the rails. Instead of the list of maimed having been added to, it has really been detracted from, when one considers that prevented accidents remain unheralded, while casualties of the day are in print almost as soon as they occur. Nearly every department of railroad service has been safeguarded, although of course the good work must be continued to bring the most noticeable results. Even the office janitor who once clung to the window sill with his toes while washing the outside of windows is now provided with a window sill extension platform upon which to place his feet. Double tracks prevent head-on collsions. Block signal systems and special telephone service aid the dispatchers in keeping trains apart. The efficiency of train and engine men was never higher. Shop men, too, are more careful than formerly.

The feature of safeguarding railroad shops, however, is one which has generally been left with master mechanics to rectify, on account of their aptitude for bettering shop conditions. The keen, trained eye of the master mechanic discerns impending danger and he safeguards the shop against accidents in numerous ways, while if others were handling the matter something dangerous would likely be passed unobserved and an accident result.

"Safety First," in fact, is now the slogan in railroad shops. It is simply a new dress for the old adage, "An ounce of prevention is worth a pound of cure." But a slogan, of itself, cannot keep workmen on the alert, and therefore under the head of "Acquire the Safety Habit" should be assembled all those specific details which are likely to cause shop accidents. A master mechanic knows many of these salient causes of casualties from his extended shop practice and experience as a mechanic. He knows what accidents are most likely to occur under ordinary conditions and rectifies those conditions so as to overcome damage to shop property and prevent injuries to his workmen.

There are, of course, a few conditions over which a master mechanic may have no control. He may be required to work his men with antiquated machines which were known to be "man killers." However, operating officials have awakened to the fact that there is no efficiency in giving a workman any kind of old machine to work with, for the reason that where the same workman is given an up-to-date machine he can work almost free from danger, as well as turn out more work and of better quality.

A master mechanic is apt to be the most successful in avoiding shop accidents where he embodies his safeguarding knowledge in a book of rules which sets forth what accidents have been of the most frequent occurrence in different shops in times past, and defines the best methods of overcoming their reoccurrence. This classification gives foremen and others ideas as to irregularities which lead to accidents and how to remedy them.

While a master mechanic may be able to accomplish much in safeguarding his shops by his own observation, yet he will likely effect more improvements by using his different foremen as helpmates in bettering conditions of safety in their respective departments, additionally to his own betterments made from time to time. Several pairs of experienced eyes can see more than a single pair. Foremen should be required to suggest improvements or betterments which make the shop a safer working place.

The master mechanic may look over the equipment and fixtures of a single department in connection with his foreman and designate such safeguarding measures against accidents as

are essential for the prevention of casualties, and he can then look into conditions of safety in other departments, but he should not drop the matter here, as he has only begun to rectify conditions which cause accidents.

The numerous rules in his book on "Safeguarding the Shop Against Accidents" may be paragraphed under such headings as:

"Line shafting, pulleys and belting."

"Individual machines: operation, speed and care."

"Precautions to be taken by workmen."

"Rules governing the handling of cranes."

"Roundhouse dont's."

"Safety kinks for car men."

A great deal of pertinent information pertaining to safeguarding the shop and its workmen can be embodied in a working memorandum or book of rules on the Safety Habit. Those here mentioned are but few owing to lack of space. The main thing is to systematize, under pertinent headings, the different safeguard measures. This list can be added to yearly. Preferably, the book should have many headings, as for instance, one simply for line shafting. This feature facilitates revisions or additions being made under the different paragraphs. After the book has been revised and reissued several times it will probably contain as many rules as are in the M. C. B. code. Of course, the rules can be in a typewritten memorandum at first and afterwards printed in book form.

The rules of one master mechanic may differ somewhat from those of another master mechanic, for the reason that shop conditions vary and each master mechanic will want his safety rules to refer to his shops in particular, although there are general points which may refer to all railroad shops.

The matter of instilling into the minds of workmen the necessity for being careful at all times is a task which is probably the most difficult of being thoroughly carried out by the workers. It would seem that the warning "Don't Get Hurt" would be sufficient, but generally it is necessary to tell the men how to be careful. This, however, is not as difficult as it appears at first sight. Each man should have his place and remain there. His movements should be governed by the requirements of the operations he performs. Like a trapeze performer, he should first "examine the ropes" before making a dash. There is a right way and a wrong way of working at different machines or handling miscellaneous work, and it is necessary to show some workmen just how they should be governed in handling a machine, for the reason that they may be working on, say a drill press, for a number of months, and then, owing to lack of hands, they may be transferred onto another machine with which they are not quite so familiar. In such case their awkwardness may occasion an injury. However, with a set of rules governing the handling of each machine a new workman is forewarned and required to take necessary precautions to prevent getting hurt.

Considering the army of workmen in some railroad shops it is a wonder that personal injuries are not of more frequent occurrence than they have been. Carelessness seems to be born in some men. There is "Old Man Tobias," for instance, who was assigned to fix an overhead crane, but instead of taking his hammer down with him he just let it drop to save carrying it, with the result that the foreman has a mashed toe but is thankful it wasn't his head. The safety rule is, "Carry the hammer with you or let it down with a string."

Among the laborers are those who may see well but hear or understand little on account of being of foreign nationality, and about the only way to prevent them from getting hurt is to place them under an intelligent foreman of their own nationality, who can instruct them in their daily work. A blind man once remarked, "I can't imagine how so many people get hurt with their eyes wide open." But they do get injured, and mostly through carelessness.

"Shorty" had a mania for putting rosin on the machine belt when it slipped, and became so careless as to try it without looking at what he was doing, with the result that the pulley "bit" him and he now has four mashed fingers. Belts can be shortened or tighteners used to prevent belt-slip.

Master mechanics who read shop journals may notice from time to time shop accidents which were out of the ordinary. Such news may be used as a pointer toward overcoming a similar accident. By making a notice of such occurrences a master mechanic will soon have a file relating to every heading in his safety rule book, and may wish to include them in the book when reissuing it.

Where a shop has instructors as well as foremen they may be required to teach safety along with mechanics. Apprentices are sometimes more or less awkward or green and may get injured by doing some foolhardy thing which an old-timer would call crazy.

The master mechanic may appoint a "Safety Engineer," whose duty should be that of devoting his attention to safeguarding the shop against accidents. An old employe, with all-around experience, oftentimes makes an efficient man in this position. Of course, he should report to the master mechanic all irregularities found, as well as overcome such dangers as the master mechanic may designate. Should an injury occur to a workman, the safety engineer should obtain all particulars and reduce them to writing for the claim department.

Floor work on locomotives has dangers which require safeguarding. One of a dozen things might occur which would cause an injury while an engine or its parts are being hoisted or moved, and it is necessary for the workmen to follow ironclad rules in order to avoid an accident. Considering that a locomotive is now as large as a house, and probably weighs many tons more, it goes without saying that when a gang of workmen is overhauling it they need to be careful and work in unison to prevent getting hurt.

Where a shop has the machines so close together that the workmen have scarcely elbow room there is always danger of the man at one machine having a mishap which may injure men at other machines, and consequently the workmen should be mindful of their limited space and of the presence of each other.

Generally speaking, the matter of safeguarding the railroad shop against accidents is one of systematizing the work, cautioning the workmen, and having foremen, instructors and others always on the lookout for remedying irregularities as they observe them. Additionally, a book of safety rules will help in preventing accidents, for the reason that the slogan or admonition, "Safety in all things," is insufficient without being reinforced with pertinent mention of what to avoid and how to do this in a practical way.

AMERICAN RAILWAY ASSOCIATION MEETING.

The spring session of the American Railway Association will be held at the Biltmore hotel, New York City, on Wednesday, May 20, 1914, at 11:00 a. m. Reports will be presented by the following committees: Executive committee, committee on transportation, committee on maintenance, joint committee on automatic train stops, committee on relations between railroads, committee on the safe transportation of explosives and other dangerous articles, committee on electrical working, and committee on nominations. The election of a president and a first vice-president will take place at this meeting. Two members of the executive committee, three members of the committee on transportation, three members of the committee on maintenance, three members of the committee on relations between railroads and three members of the committee on nominations are to be elected.

The Wisconsin division of the Chicago & North Western has been awarded the banner for making the best record in the Safety First campaign on that road during the past year.

FRENCH LOCOMOTIVE IMPROVEMENTS.

Recently a number of most exhaustive tests, probably the most exhaustive ever carried out in Europe, have been conducted between simple and compound locomotives, in each case with superheated steam, on the Paris, Lyons & Mediterranean Railway. The results are, of course, of most particular interest to countries like Italy and Switzerland, where high prices have to be paid for the foreign coal delivered to their engine tenders. At the same time all railway companies may benefit by their careful study, for they have an important bearing on the economizing of fuel resources in every country. These tests were made in the most difficult section of the line between Paris and Marseilles, from Laroche to Blaisy-Bas, a continuous incline of saw-tooth profile, 83 miles long, terminating in a gradient of 1 in 125, the total v rtical rise being about 1,050 ft. With a load of 456 tons behind the tender the simple engine ran the distance in 98 minutes 45 seconds, developing an average of 1,178 drawbar h.p., and consuming 8,530 lbs. of coal, or 7.24 lbs. per drawbar h.p. hour, and 3.75 gallons of water per h.p. hour. With 487 tons behind the tender the compound engine ran the same trip in 87 minutes 2 seconds, developing an average of 1,246 drawbar h.p., consuming 6,860 lbs. of coal (5.5 lbs. per drawbar h.p. hour), and 3.24 gallons of water per h.p. hour.

Thus the compound hauled a load 8 per cent heavier in 11 per cent less time with a total coal consumption reduced by nearly 20 per cent, and a coal consumption per drawbar h.p. hour reduced by 20.3 per cent. In a second run with a load of 487 tons the time taken by the compound was still less—85 minutes 39 seconds —but the higher speed entailed a greater consumption of coal—7,050 lbs. With a smaller load the speed of the compound was even more remarkable. A load of 278 tons was hauled in 77 minutes 14 seconds, the consumption of coal being 4.56 per drawbar h.p. hour, while the simple engine, with 272 tons, took 90 minutes and 40 seconds, and burned 55.70 lbs. of coal per drawbar h.p. hour. In this case, therefore, the compound saved 14 per cent in time and 18 per cent in fuel. The average start to stop speed was 64.5 miles an hour.

So far as the dynamometer records go they reveal extreme regularity of speed and power with the compound, whereas the lines of speed and power with the simple engine are "hillocky," indicating that it was specially sensitive to variations in resistance due to ups and downs of the line. They show that the boiler of the simple engine was more severly taxed to supply steam for four large cylinders than was that of the compound to supply two small cylinders. A smaller boiler, therefore, suffices for the compounds, and the latest engines are designed accordingly. In consequence of this demonstration of the superior speed, power, and economy of the compound, and its greater elasticity, or higher power range, the Paris, Lyons & Mediterranean Railway has ceased to build simple engines, and has at work or under construction 85 new compounds, of the Pacific type, weighing 1.6 tons less than the simple engines, yet 7 or 8 per cent more powerful than the compound with which the above results were obtained. Behind these engines travelers to the Mediterranean will be conveyed in heavier paying train loads, at higher speeds, and at less cost for fuel. The engines are rated for 10 per cent heavier train loads, and at the same time their speed capacity is 10 per cent higher than simple engines of greater weight.

The Paris, Lyons & Mediterranean has also conducted elaborate tests on a large scale between engines of the same type, using saturated and superheated steam. These tests showed that while there was an economy in coal of about 17 per cent with superheated steam during the tests, yet the power developed, per cubic foot of steam used and per pound of steam pressure entering the cylinder, was from 14 to 23 per cent less than with saturated steam. These figures agree fairly well with the steam tables generally used, which show that, at the pressure and maximum temperatures employed by the Paris, Lyons & Mediterranean, the specific internal energy in each cubic foot of superheated steam is 23 per cent less than in theoretically dry saturated steam.

In practical working there is an important difference between the relative economies possible with superheating and with compound expansion. With superheating an economy of 17 per cent in coal can be guaranteed provided that the steam is kept at a certain temperature almost uninterruptedly. With a compound engine having a ratio of cylinder volumes of 1 to 2.85 the draughtsman can guarantee from his preliminary calculations a coal economy of 25 to 35 per cent, provided the drivers are unable to alter the difference of the cut-off in the two-stage cylinders by more than 3 per cent; the engine then economizes 30 per cent of steam at each stroke, and the economy of coal will be about equivalent, no variation being possible. But with superheated steam the conditions that influence coal consumption vary at every moment, with the height of the water in the boiler, the condition and depth of the fire, the amount of regulator-opening, the distance run without stopping, and other factors. The result is that the coal economy realized in trials falls off in regular service by from 10 to 20 per cent, sometimes leaving, in the experience of the Paris, Lyons & Mediterranean and Italian State Railway, a saving of only 3 to 8 per cent on a year's working.

The trials which were carried out by the Paris, Lyons & Mediterranean, and which resulted in the application of superheaters to the boilers of its compound express engines, gave the following results on the Laroche to Dijon line: Coal consumption per h.p. hour with saturated steam, 3.51 lbs., and with superheated steam 2.89 lbs., the saving with superheated being thus 17.57 per cent. In regular working during 14 months the monthly consumption of coal per 100 ton-kilometres run with the same engines and services averaged 9.7 lbs. with saturated steam, and 9.0 lbs. with superheated steam, or an economy of little over 7 per cent. This may be regarded as the saving in coal effected on the average by the application of superheating to engines of the Pacific compound type, and the drop in economy between the test-trip figure and the annual figure is, therefore, about 10 per cent. An expert writer on the London "Times" asks, "what will be the drop between the economy of the new compound engines as shown by the tests already referred to, and their annual economy?" To judge by the difference between test results and annual results obtained elsewhere as between simple and compound engines, the probability is that the drop will be only 3 to 5 per cent or less, according to the loading of the trains. On the Paris, Lyons & Mediterranean the drivers cannot interfere with the prearranged expansive working as they can on the engines of other French lines having two sets of reversing gear.

TOOL FOREMEN'S CONVENTION.

Will the standardization of reamers for locomotive repairs mean economy?

Do you keep costs on the maintenance of machine tools? Are some types of the same classes of machines more economical to maintain in proportion to their output?

What are the best methods of handling tools and their arrangement in tool rooms for economical distribution to the shops?

Will you profit by a discussion of the construction and use of special tools for drilling, reaming and milling; special appliances and methods for tool room grinding; dies for cold punching, drawing and bending as used in railway shops?

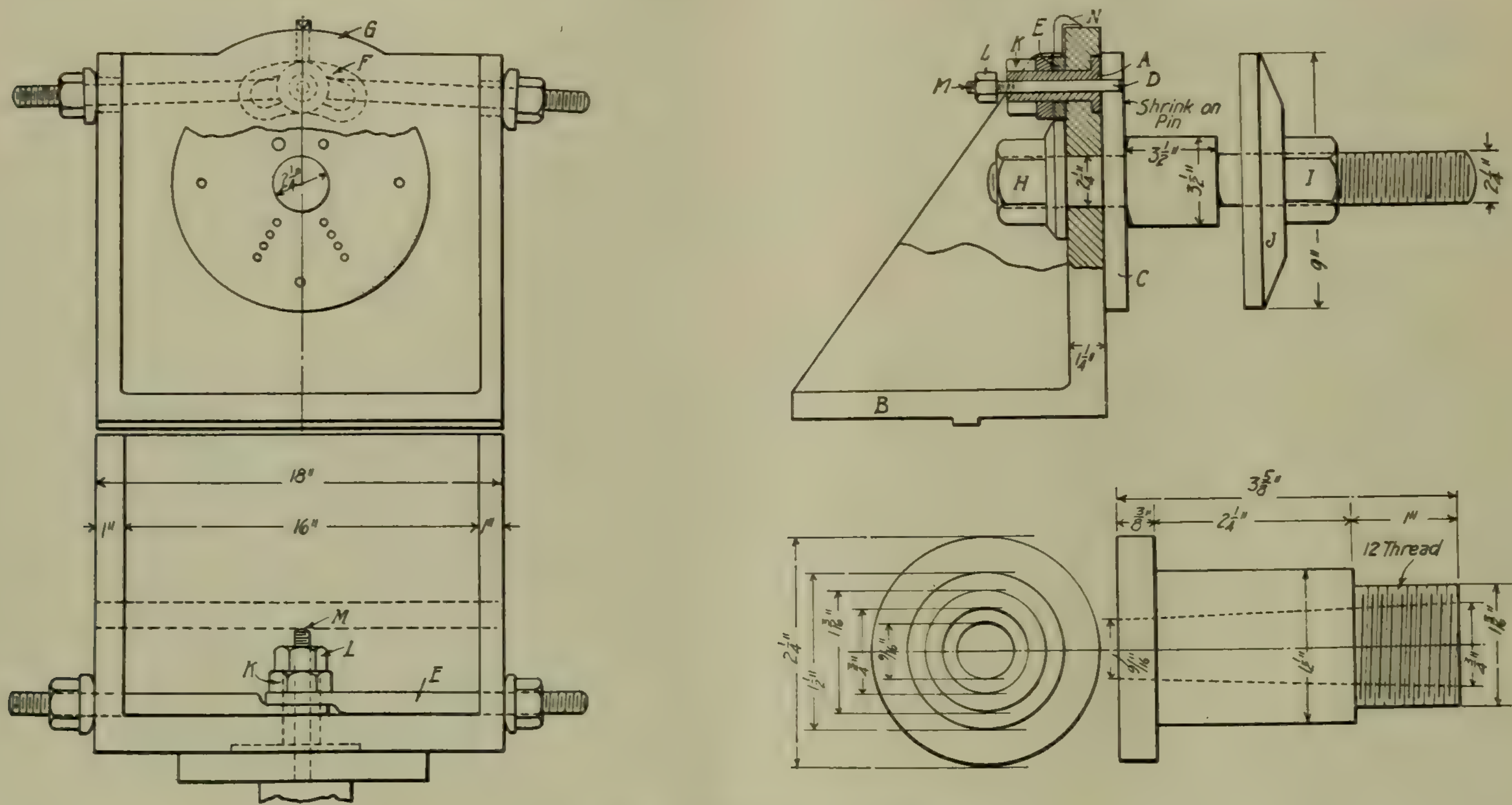
These subjects will be discussed at the sixth annual convention of the American Railway Tool Foreman's Association, to be held at the Hotel Sherman, Chicago, July, 20, 21, 22, 1914.

The head of a large business house bought a number of those "Do it now" signs and hung them up around his offices. They were effective beyond expectation, and yet it can hardly be said that they worked well. When, after the first few days, he counted up the results, he found that the cashier had skipped off with $5,000, the head bookkeeper had eloped with the typist, three clerks had asked for a raise in salary, and the office boy had set out to become a highwayman.

SHAPER ATTACHMENT.

By Daniel Freuler.

The article describing the tool room and some of the work done at the Burnside shops of the Illinois Central at Chicago was most interesting and I am sure was very much appreciated, especially by the tool foremen who are readers of the *Railway Master Mechanic*. As a result others should be encouraged to give the benefit of their experience to those who are interested by sending in their contributions and in order to keep up with the procession, even if it be only as a humble integer, I have busied myself in preparing just a small item that may be of interest and help some one by suggesting a possible way out of a difficulty. Accompanying is a sketch of an attachment for a shaper that was made by the writer while tool foreman at the Illinois Central shops at Memphis, Tenn.



Views of Shaper Attachment.

We had been planing the rod brass as best we could either in the shaper vise or clamping them on an angle plate and squaring them up with try square and level, thus spending a lot of time on the job. This did not appeal to me as being a very economical method, so I got busy and worked out an idea that seemed to promise good results. Of course the work had to be done between times while taking care of all the other work, and the material used was nearly all second-hand material.

A good heavy angle plate was bored to take a 2¼" pin with a heavy collar. The plate C was then shrunk onto the pin as shown. The next job was to cut the arc F into the angle plate, concentric with the bore. This was done first by swinging it on another angle plate, using the bore as the center after a stud had been made to fit the hole. A long socket was made for an end mill and the arc cut in the milling machine, as was also the recess for the head of the sleeve A. As will be seen at G, provision is made by cutting away the top edge of the angle plate to form an arc for quadrant which is indexed or graduated for setting the tapers. The sleeve A was bored taper, reamed with Morse standard taper reamers, and was made long enough to project through angle plate to receive the eyebolt E which passed through the webs of the angle plate and was threaded at each end. The plate C was drilled exactly on the quarter and large enough to receive the point of a Morse taper reamer. The parts were then assembled. The sleeve A was put in place after the adjusting screws with rocker washers had been inserted and the nut K screwed to the shoulder. The pin with plate C was put in place and rotated until the taper reamer entered the first hole. This was then reamed to fit pin M. Then in order to insure the correct alignment of the rest of the holes, a sleeve was fitted to the enlarged hole of the sleeve or bushing A and reamed to permit the point of the reamer to enter the hole in plate C. This also was reamed and so were the succeeding holes. Then in order to facilitate the handling of the brasses and getting approximately centered on the pin, a series of concentric holes were drilled in plate C as indicated, into which pins were fitted and upon which the brass was placed and clamped by means of washer J and nut I. With the brass thus clamped it could be rotated by simply loosening up the nut H. In operating the jig the brass could be turned on the quarter by withdrawing pin by means of nut L, loosening nut H and bringing the hole on the next quarter in line with the hole in the bushing A and finally pushing in the pin. After tightening up the nut H, proceed. To adjust for the taper, nut H is loosened and the adjustment made with the adjusting screws E by moving the bushing A in whichever direction the taper is desired, the angle plate having been graduated at G and the bushing provided with an index finger N. When the desired taper is found, tighten nut H and proceed. This made a very serviceable tool and it cut down the time of planing the brasses over 50%. However, since the attachment has been in use the shops have been equipped with a Morton draw cut shaper.

MEMBERSHIP OF RAILWAY ASSOCIATIONS.

The following data is interesting as showing the enrollment and age of the various associations in the railway mechanical field:

	Enroll-ment.	Members at last convention.	Years in existence.
Air Brake Assn.	1,188	271	20
C. Int. Car. Ins. & C. Fmns. Assn.	358	160	14
General Foremen's Assn.	214	78	9
Master Blacksmith's Assn.	277	110	21
Master Boilermakers' Assn.	788	289	7
Master Car Builders' Assn.	878	338	47
Master Mechanics' Assn.	1,073	367	46
Railway Fuel Assn.	523	278	5
Tool Foremen's Assn.	92	50	5
Traveling Engineers' Assn.	957	290	21

Personals

T. McClain succeeds W. L. Essex as master mechanic of the *Arkansas, Louisiana & Gulf* with office at Monroe, La.

W. F. Gallup succeeds I. H. Drake as general foreman of the *Atchison, Topeka & Santa Fe* at Raton, N. M.

J. A. Baker succeeds H. M. Muchmore as foreman of the *Atchison, Topeka & Santa Fe* at Belen, N. M.

E. C. Comstock has been appointed road foreman of engines of the *Atchison, Topeka & Santa Fe* with office at Clovis, N. M.

C. A. Gill has been appointed assistant district superintendent of motive power of the *Baltimore & Ohio,* succeeding J. W. G. Brewer, resigned. His office is at Baltimore, Md.

Henry Gardner has been appointed assistant superintendent of shops of the *Baltimore & Ohio* with office at Mount Clare, Baltimore, Md. Mr. Gardner was formerly supervisor of apprentices of the New York Central & Hudson River.

W. H. Rieckmann has been promoted to master mechanic of the *Boston & Maine* at Mechanicsville, N. Y.

George A. Wyman has been promoted to master mechanic of the *Boston & Maine* at Concord, N. H.

L. C. Ord has been appointed assistant master car builder of the *Canadian Pacific* at Montreal, Que., succeeding P. A. Crysler, assigned to other duties.

W. F. Heiser, master mechanic of the *Chicago & Eastern Illinois,* has been transferred from Villa Grove, Ill., to Evansville, Ind.

F. Studer, master mechanic of the *Chicago & Eastern Illinois,* has been transferred from Evansville, Ind., to Villa Grove, Ill.

F. Kubeck succeeds G. H. Matthews as shop foreman of the *Chicago & North Western* at Green Bay, Wis.

L. A. Stoll, assistant superintendent of the Aurora, Ill., shops of the *Chicago, Burlington & Quincy,* has resigned.

C. W. Robertson has been appointed general foreman, locomotive repairs, of the *Chicago, Burlington & Quincy* at Aurora, Ill.

H. A. Crance succeeds C. E. Lowe as road foreman of locomotives of the *Chicago, Burlington & Quincy* at Brookfield, Mo.

R. D. Long succeeds E. J. Roth as assistant general storekeeper of the *Chicago, Burlington & Quincy* with office at Chicago.

M. A. Monahan succeeds H. W. Ensign as master mechanic of the *Chicago Great Western* at Chicago, Ill.

C. McLean succeeds H. Brinkman as locomotive foreman of the *Chicago Great Western* at Oelwein, Ia.

J. H. Sims succeeds J. G. Lewis as general foreman of the *Cincinnati, New Orleans & Texas Pacific* at Ludlow, Ky.

J. G. Lewis has been appointed road foreman of engines of the *Cincinnati, New Orleans & Texas Pacific* at Ludlow, Ky., succeeding J. J. Donovan.

A. J. Barrett has been appointed assistant master mechanic of the *Cleveland, Cincinnati, Chicago & St. Louis* at Bellefontaine, O. Mr. Barrett commenced railway work in 1888 as a machinist apprentice at Mattoon, Ill., and worked at the trade until November, 1899, when he was made roundhouse foreman at East St. Louis, Ill. On November 1, 1901 he was transferred to the same position at Mattoon, Ill., and on December 1, 1912, was made general foreman at Mattoon, which position he held until his present appointment. His entire service has been with the Big Four.

B. F. Orr has been appointed division car foreman of the *Cleveland, Cincinnati, Chicago & St. Louis* with office at Indianapolis, Ind. He succeeds A. G. Brown.

Mark Baer has been appointed master mechanic of the *Colorado, Kansas & Oklahoma.* His office is at Scott City, Kan.

James Desmond succeeds J. S. Tanney as road foreman of engines of the *Delaware & Hudson* at Watervliet, N. Y.

R. A. Logan has been appointed master mechanic of the *Denver, Laramie & Northwestern* with office at Utah Junction, Colo. He succeeds J. H. Bender.

P. H. Maley has been appointed general foreman of the *Minneapolis & St. Louis* at Oskaloosa, Ia., vice J. D. Reynolds, resigned to accept other service.

J. G. Costello has been appointed general foreman of the *Denver, Laramie & Northwestern* with office at Denver, Colo.

F. A. Phillips succeeds R. Lloyd as locomotive foreman of the *Great Northern* at Great Falls, Mont.

A. D. McCharles succeeds F. W. Ramer as locomotive foreman of the *Great Northern* at Havre, Mont.

A. L. Tetu succeeds J. Becker as car foreman of the *Great Northern* at Cass Lake, Minn.

Z. Ramsdell succeeds O. H. Hanson as car foreman of the *Great Northern* at New Rockford, N. D.

O. H. Hanson has been appointed car foreman of the *Great Northern* at Minot, N. D., succeeding William Smith.

R. H. Gaddus succeeds J. H. Wran as foreman tin and pipe fitting shops of the *Intercolonial of Canada* at Moncton, N. B.

A. E. Fischer succeeds W. H. Johnson as master mechanic of the *Interstate* with office at Stonega, Va.

F. Heim succeeds E. J. Hazelton as master car builder of the *Midland Continental* with office at Jamestown, N. D.

B. D. Richardson succeeds James Carr as master mechanic of the *Midland Valley* with office at Muskogee, Okla.

John Feld has been appointed acting boiler maker foreman of the *Minneapolis & St. Louis* at Marshalltown, Ia., succeeding P. H. Maley.

A. H. Firnhaber has been appointed master mechanic of the *New Iberia & Northern.* His office is at New Iberia, La.

Wilbur D. Arter has been appointed supervisor of apprentices of the *New York Central & Hudson River,* vice Henry Gardner, resigned.

G. F. Denne succeeds C. Clark as foreman painter of the *New York, Chicago & St. Louis* at Chicago (Station S).

John Hallman succeeds G. H. Huntley as master mechanic of the *North Louisiana & Gulf* with office at Hodge, La.

A. C. Hinckley has been appointed superintendent of motive power and machinery of the *Oregon Short Line,* with headquarters at Salt Lake City, Utah. He succeeds J. F. Dunn, resigned. Mr. Hinckley was formerly master mechanic of the Southern Pacific at Oakland, Cal.

L. L. McGowan succeeds J. Caron as master mechanic of the *Pacific & Idaho Northern* with office at New Meadows, Ida.

Wilfred F. Heinbach succeeds J. K. Downs as engine house foreman of the *Philadelphia & Reading* at East Penn Jct. (P. O. Allentown), Pa.

G. W. Hayden has been appointed assistant to the chief purchasing officer of the *St. Louis & San Francisco* with office at St. Louis, Mo.

P. O. Wood has been appointed superintendent of locomotive performance of the *St. Louis & San Francisco,* vice Robert Collett, resigned. His headquarters are at Springfield, Mo.

Robert Collett, superintendent of locomotive operation of the *St. Louis & San Francisco,* has resigned to accept a position with the Pierce Oil Co. with office at St. Louis.

W. H. Malone has been appointed assistant superintendent locomotive performance of the *St. Louis & San Francisco* with office at Springfield, Mo.

J. W. Coker succeeds H. M. Shular as general foreman car department of the *St. Louis & San Francisco,* with office at Memphis, Tenn.

Thomas Long succeeds H. F. Kirkpatrick as division foreman of the *St. Louis & San Francisco* at Harvard, Ark.

H. H. Parker has been appointed master mechanic of the *Seaboard Air Line* with office at Jacksonville, Fla.

J. W. Adams succeeds B. E. Greenwood as shop superintendent of the *Seaboard Air Line* at Portsmouth, Va.

W. C. Rogers, road foreman of engines of the *Seaboard Air Line,* has been transferred from Jacksonville, Fla., to Savannah, Ga.

F. L. Stockwell has been appointed road foreman of engines of the *Seaboard Air Line* at Raleigh, N. C.

E. O. Holland succeeds W. O. Wilson as master car builder of the *Snowbird Valley* with office at Andrews, N. C.

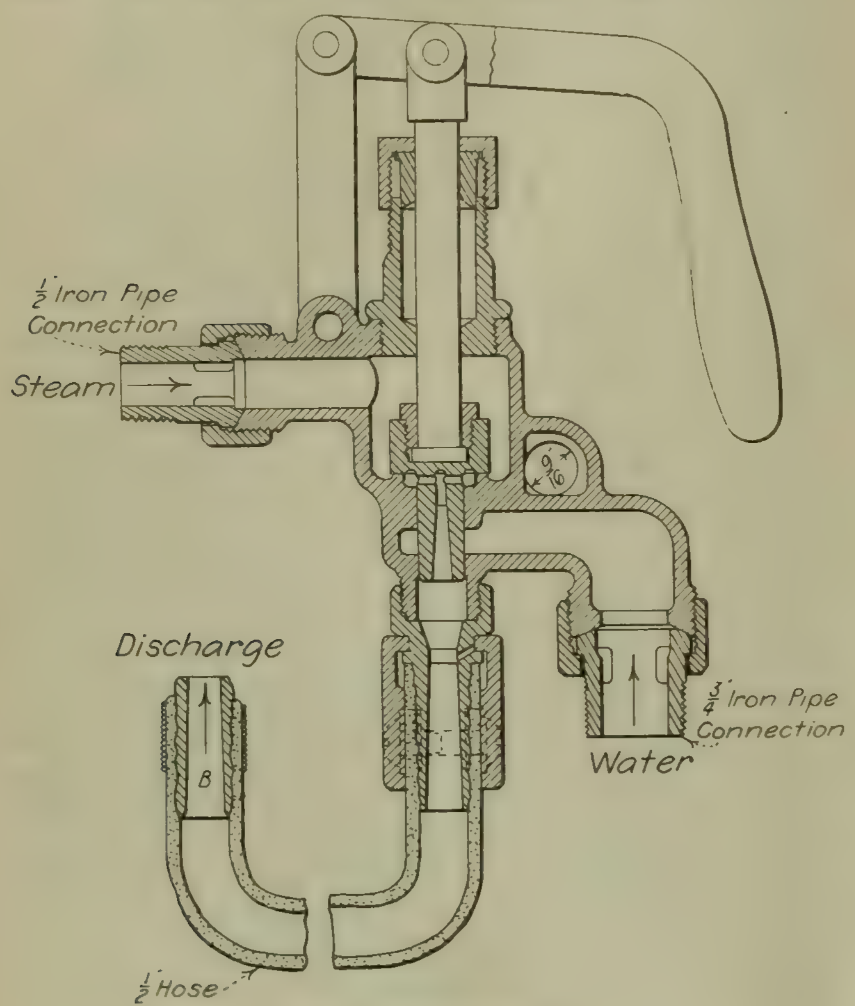
J. A. Boatright has been appointed acting master mechanic of the *Tallulah Falls,* vice A. M. Heckle. His office is at Cornelia, Ga.

Among The Manufacturers

NATHAN COAL SPRINKLER.

The Nathan Mfg. Co., New York, has developed a new device for operating the sprinkling hose on locomotives. The apparatus works on the ejector principle and is very simple in construction.

The most important feature is, of course, the arrangement of valves, which prevents steam from going through the hose in case the water supply is obstructed. Nothing but luke warm water issues from the hose nozzle at any time. A cross section of the sprinkler is shown herewith. It is installed near the injector at a convenient height from the deck and is operated simply by the pull of one lever. Water is taken from the injector supply and steam from a convenient fitting.



Nathan Coal Sprinkler.

The device seems to be a marked improvement over other types and it is rapidly being adopted on the large railways.

WAHLSTROM AUTOMATIC DRILL CHUCK.

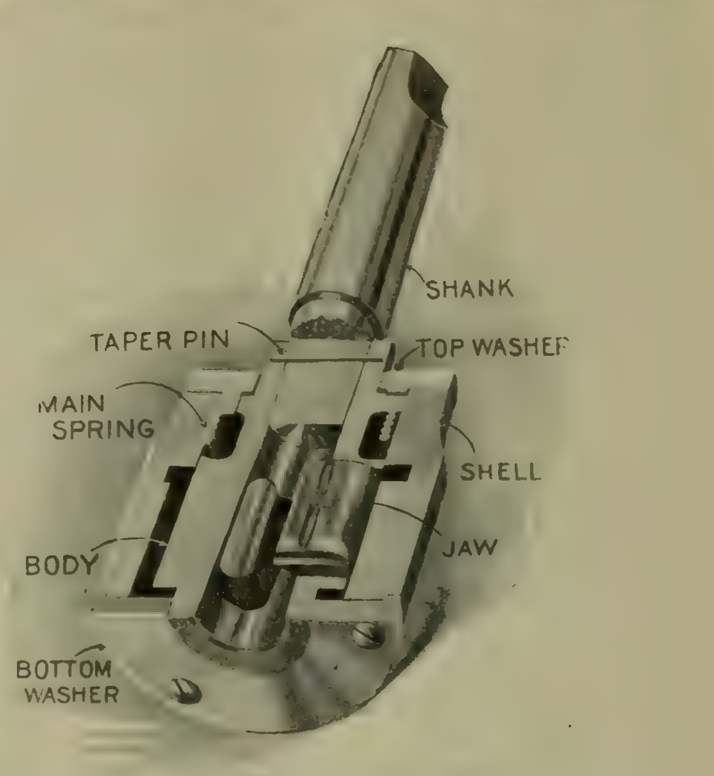
The chuck shown in the illustration has been placed on the market by the Wahlstrom Tool Co., 346 Carroll street, Brooklyn, N. Y., and possesses a number of features which effect an economy of time and labor. The outer shell of the chuck is spring held in the direction in which the chuck is rotating, therefore the jaws are always, under normal conditions, moved towards the center of the chuck by the eccentric cam faces in the shell.

By gripping the shell with the hand when the chuck is in motion, the rotation of the shell is stopped momentarily, thereby changing its relation to the body and allowing the jaws to fly out by momentum towards the cam faces in the shell.

The resistance developed when pressure is exerted on the drill causes a rocking motion of the gripping members which are provided with eccentric gripping surfaces.

The holding power of the rockers increases with the resistance on the drill.

The chuck holds tools with or without tongs and it will take taper shank drills ranging in size from ¼ inch to 1¼ inch. It is guaranteed to pull any top up to the full capacity of the chuck. The chuck is also made in sizes adaptable to straight shank drills. It does away with collets, does not mar the drill shanks and the saving in time alone, in changing of drills, will soon offset the original cost of the chuck, it is said. At a test of the chuck using a Cleveland twist drill of 15/16 inch diameter on a piece of 1 x 5 inch steel, a cutting speed of 90 feet per minute was obtained. The feed was .017.



Wahlstrom Automatic Drill Chuck.

ARC WELDING.

The subject of arc welding is receiving a great deal of consideration at the present time by railways and industrial concerns because of the many advantages it possesses for certain kinds of work.

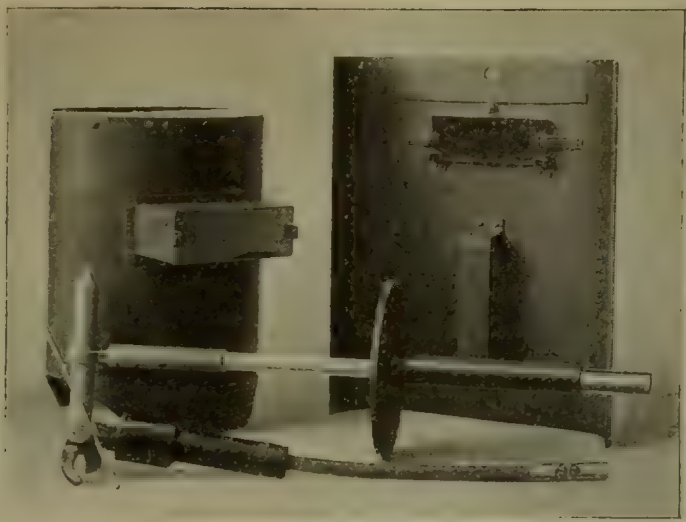
Arc welding is particularly adapted to various uses in machine shops and foundries. Worn parts of machines can be built up prior to machining and broken parts of steel castings can be welded together. Often defects develop in new castings, after considerable machining has been done. The machining and castings, in many cases, can be saved by repairing with the electric arc. Castings with blow-holes and sand holes can often be very quickly repaired. Risers and sinkheads can be cut off.

In steam locomotive shops metal pencil welding is used extensively in fire box and boiler repairs, flue welding, repairing steel locomotive frames, building up mud rings and general work of this character. A large amount of equipment that would have to be scrapped can thus be repaired with the electric arc, and a large saving in money, time and labor effected.

In electric railway shops arc welding can be used to special advantage in repairing broken armature shafts, axle brackets and motor frames. In track equipment, the repair of broken frogs, cross-overs and other work of this nature can be done with excellent results.

In steel mills there are many places where the electric arc can be used to great advantage, often resulting in a considerable saving. The ends of wobblers and pinions, which have become badly worn, can be built up to their original size. Tap holes in blast furnaces can be burnt out in a very short time.

Realizing from past experience the practical value of the electric arc for general welding purposes, the Westinghouse Electric & Manufacturing Company has developed a standard line of electric arc welding equipments which are simple in construction and easy



Shield, Hood and Carbon Holder.

to operate, complicated relay schemes for automatically inserting resistances being eliminated. Ample protection is secured by circuit-breakers and special arrangement of the resistance.

The outfits are furnished complete in the four following sizes: 200, 300, 500 and 800 amperes. Each equipment includes a welding generator, or a welding motor-generator set, switchboard, control and all necessary accessories. The welding generator consists of a special 75-volt, commutating-pole, direct-current machine, either belt or motor-driven.

The instrument and control panels are composed of two sections. The upper section contains the indicating instruments, protective apparatus and switches arranged for regulating the welding current, and the lower section contains the starting and protective equipment for the motor-generator set. It is often desired to have several welding circuits connected to one generator. For this arrangement a control panel is provided for each circuit. Each panel can be located at the most desirable place. Metal or carbon pencil welding can be done from any of these panels, independent of all others and one or more arcs can be operated simultaneously.

The accessories furnished consist of a carbon holder and a hood for protecting the operator together with a shield and a metal pencil holder for each welding circuit.

Repairing Broken Locomotive Frame.

The equipment is the result of eight years' experience in the company's own shops and has been employed on all classes of commercial work, thus ensuring a thoroughly practical shop outfit.

SEARCHLIGHT GAS FOR SHOP WORK.

For cutting or welding by the oxy-acetylene process the Searchlight Co., Karpen Bldg., Chicago, has developed a service for supplying acetylene in high pressure tanks in the same manner that oxygen is handled.

The shop operator is expected to purchase a complement of tanks after which he is supplied in exchange, as needed, filled tanks for exhausted ones. Branches and refilling stations are located at convenient points and the service has proved much more satisfactory in most cases than the old method entailing small generating plants in the shops where the gas is used.

The Searchlight Co. has adopted the policy of charging for the gas by weight, thus avoiding the results of variations in the content of the tanks. It also allows the use of its tanks for experimental purposes without the necessity of investment, by payment of a slightly higher rate. The tanks are seamless steel cylinders which have passed all legal requirements. They are made in three sizes: 100 feet, 225 feet and 500 feet.

IMPROVED EYE PROTECTORS.

During a recent discussion of safety devices for employes it was stated that in the adoption of goggles to be worn by grinders, chippers and other employes of shops it is not a problem of satisfying the boss, but rather one of satisfying the employe who must wear the goggles.

Employes wearing eye protectors frequently have objected to their use, owing to the discomfort of the saddle bridge resting on top of the nose. To overcome this difficulty T. A. Willson & Co., Inc., Reading, Pa., have designed an eye protector, shown in the accompanying illustration, provided with an adjustable brace bridge which removes all of the weight from the top of the nose and distributes it uniformly upon the sides of the nose and cheeks, thereby removing the objection to wearing protectors with the bridge resting directly on the nose. By this design of bridge adjustment of protectors to every face is possible, so that the usual open space between the nose and lenses is closed, thereby shutting out chips from this point of danger. A safety flange which forms a part of the rim extends over the back of the glass, imparting added resistance to any blow on the lenses and holds the broken glass securely, thereby preventing the splinters from injuring the eyes.

The wire side screens are made either detachable or are fastened so that they cannot be removed. The screens are long and narrow, to insure perfect protection without irritation caused by the edges rubbing and cutting into the cheek and forehead. The screens

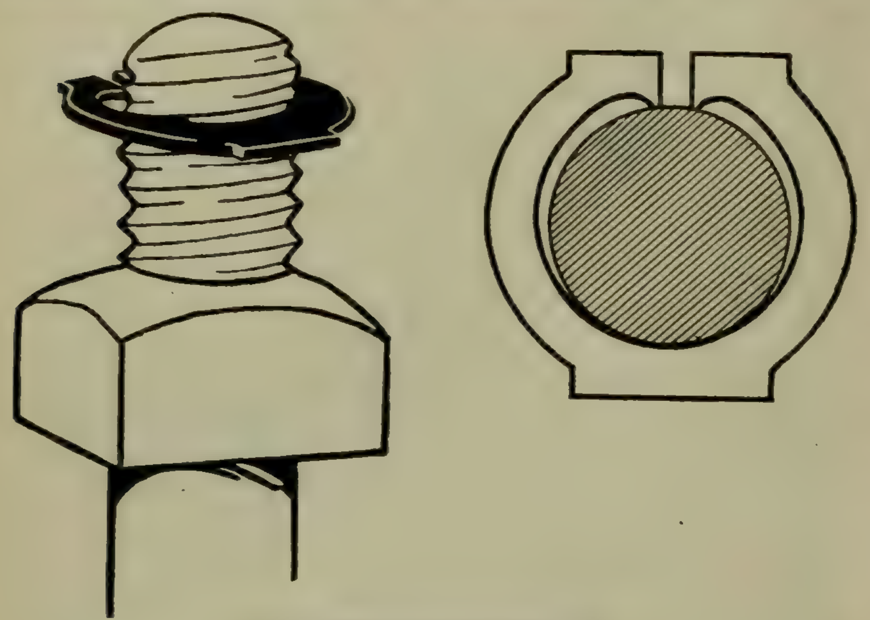
Willson Eye Protector.

extend outside of the cable bow temples, thus insuring cleanliness in the screw joint and eliminating the danger of the cable bows breaking at the joint where there is a constant strain if the bow extends outside the wire screen. The glass is claimed to be optically perfect and is ground and polished on both sides. The cable bow temples rest easily about the ears and hold the glasses securely in place. By means of the screw joint, broken lenses

are easily replaced and this effects great economies in the use of protectors, enabling each plant to make its own repairs. The frame is made of rust-proof white metal and is readily sterilized.

HUNT NUT LOCK.

The Hunt cross thread nut lock is applied after the nut is drawn up and consists of a washer-like piece of steel having three points of contact with the thread of the bolt. These points fit snugly into the thread groove, the nut lock being screwed along the threads and wrenched firmly into position against the nut. It has



Hunt Cross Thread Nut Lock.

been thoroughly tested out on track bolts and cars and has been found to be entirely satisfactory, no tightening being necessary at any time. It can be manufactured at about a third of the cost of the ordinary nut lock and it is being used on a number of large systems. It is now being made in a square form instead of the form shown in the illustration, which will allow the wrench to handle it more easily. It is being placed on the market by Hubbard & Co., of Pittsburgh, Pa.

ALLOYED STEELS FOR TOOLS.

The Century Tool and Metal Co., 180 N. Market St., Chicago, has placed on the American market alloyed steels for high speed tools which have given exceptionally good results in England where thorough tests have shown them to be capable of operating at higher speeds and with heavier cuts than has heretofore been expected of high speed steel.

This company has issued an instructive catalog on the subject of steel alloys from which the following is quoted:

Is is important to place the alloy in the hands of a good tool dresser. It is a fact acknowledged by large users, that most often trouble which is experienced with tool alloy is due to the way the alloy is hardened and not with the alloy itself. Very often the best alloy entered in a test will fail to show best results on account of carelessness in hardening.

It is a good plan to order alloys thoroughly annealed, as the long annealing process gives it a uniformity practically impossible to obtain in the ordinary shop. High speed steel can be rendered nearly as soft as common alloy by proper annealing so that it is a comparatively easy matter to machine and forge tools from it.

For the successful study of alloy it is very necessary to consider primarily: (1) The way or ways in which the alloy acts. (2) The proximate as well as the ultimate composition of the alloy.

In no alloy is this of more importance than in the case of molybdenum, which acts on alloy in at least three totally distinct ways, as described in many treatises, and which alloy furthermore must be used with a reasonable amount of intelligence on account of its very great avidity for oxygen and of its oxygenated product forming a powerful acid.

In spite of much work in all directions many points exist in connection with alloy which to date await satisfactory explanation.

It has long been known that alloy of the same analysis made by different processes vary considerably in their mechanical properties.

With regard to similar composition, would place alloy made by different processes in the following order:

(1) Coke fired crucible (''white'' or ''black lead'' pot). Gas fired crucible (''black lead'' pot). Electric furnace.

Vanadium even in small doses has the property of combining with both oxygen and nitrogen at high temperatures. In fact, it acts as a purifier or cleanser in driving them out of the metal. So powerful is its influence on nitrogen that one-half of one per cent is sufficient to eliminate nitrogen entirely. In introducing this amount, about one-half of the vanadium will be found in the steel and the presence of even one-tenth of one per cent in the finished alloy is a guarantee that the nitrogen has been separated from the alloy and driven out.

A great many people think that it is not a paying proposition for them to buy the very best high speed alloy as their machinery is not strong enough to use the alloy on heavier cuts, or faster speeds.

In regard to this, numerous tests have proven that an alloy that will cut at 10% faster speed will last twice as long between grindings (if the speed is not changed) and an alloy that will stand a 20% faster speed will run four times as long between grindings. An alloy that will stand 30% faster speed before it reaches the breaking-down point, will last eight times as long without sharpening, if the same speed is used.

New Literature

The Johnson Thermoline Valve Co., of Kansas City, Mo., has issued a booklet describing its thermoline valve, which is a regulator for portable heating and is used in connection with setting locomotive tires, welding, etc.

* * *

Circular 1010B of the National Machinery Co., Tiffin, O., describes the National one-inch, six-spindle, semi-automatic nut tapper. This machine will tap all sizes of nuts from ½ inch to 1 inch and is also built in the 1½-inch size. It handles hot pressed nuts as readily as cold punched nuts.

* * *

The subject of part catalogue No. 3202-1 of the Westinghouse Air Brake Co. is ''Air Brake Equipments and Schedules,'' and it supersedes the issue of January, 1908.

* * *

''Drill Chips'' is the name of an interesting and unique little publication for which the Cleveland Twist Drill Co., of Cleveland, O., is responsible. It contains a lot of live reading matter and common sense which make one quite willing to read the page or two devoted to Cleveland twist drills.

* * *

The Power Specialty Co., 111 Broadway, New York, has issued advance catalogue sheets on Foster locomotive superheaters. It contains descriptions and illustrations of this superheater, the first installation of which was made on the Pennsylvania Lines about two years ago.

* * *

Record No. 76 of the Baldwin Locomotive Works is a catalogue descriptive of logging locomotives recently built by them. Illustrations and dimensions of some forty-six locomotives are given, together with illustrations of a number of geared locomotives.

* * *

The Watson-Stillman Co., of New York, has published catalogue No. 91, dealing with hydraulic jacks and lifting tools. The catalogue contains 96 pages and covers many types of jacks, together with their accessories.

* * *

''How to Build Up Furnace Efficiency'' is the title of a handbook on fuel economy published by Jos. W. Hays, Rogers

Park, Chicago. The book is 5x7 inches in size, contains 126 pages and is bound in paper. It is divided into the following five sections: Why your fuel is wasted; How your fuel is wasted; How to spot your fuel wastes; How to stop your fuel wastes; How to keep the wastes stopped. The author in the latter chapter sets forth the advantages of gas collectors and recorders in order to ascertain just what the furnace is doing. The price of the book is $1.00.

The Selling Side

J. W. DUNTLEY, who designed the Duntley pneumatic hammers and riveters which are now extensively used in building construction, shops and elsewhere, has turned his attention to the building of pneumatic sweepers. His long experience with compressed air led him to see its advantages for cleaning purposes, and the result was the formation of the Duntley Pneumatic Sweeper Co.,

J. W. Duntley.

with offices at 6501 South State street, Chicago. The sweepers are made in various styles and sizes, for use in homes, offices and parlor cars.

JOHN E. CHISHOLM, railway and engineering supplies, has moved his office from the Old Colony building, Chicago, to larger quarters in the Fisher building, the move being necessary on account of increased business. Mr. Chisholm was at one time superintendent of motive power of the Chicago Great Western and has been very successful in the supply business.

F. HALLETT LOVELL, JR., has been elected president and treasurer of F. H. Lovell & Company, Arlington, N. J., succeeding James H. Callender.

THE KELLEY REAMER COMPANY, at its annual meeting April 18th, re-elected officers and directors, as follows: W. E. Kelley, president and general manager; W. A. Calhoon, vice-president; H. J. Maxwell, secretary; O. H. P. Davis, treasurer; E. B. Jessup, T. A. Torrance and George Bauer.

J. B. BERRY, who recently resigned as assistant to the president of the Chicago, Rock Island & Pacific, has opened an office as consulting engineer. The firm name will be Berry, Howard & Roberts and they will make a specialty of railway engineering. The office of the firm will be in the Transportation building, Chicago.

R. C. COLE has become connected with the pneumatic tool department of the Ingersoll Rand Company, New York, and will be located at the Chicago office.

MACARTHUR BROTHERS COMPANY has moved its Chicago office to 1892 Continental & Commercial Bank building.

WM. SELLERS & CO., INC., of Philadelphia, have taken office space in the Railway Supply Permanent Exhibit, 900 Lytton Bldg., Chicago.

THE CHICAGO-CLEVELAND CAR ROOFING CO. has removed its Chicago office from the People's Gas building to 535 Railway Exchange.

THE GENERAL RAILWAY SIGNAL CO. has increased its capital from $5,000,000 to $10,000,000.

THE TOUSEY VARNISH COMPANY has moved its Chicago offices from the McCormick building, 332 South Michigan avenue, to the factory at 520 West Twenty-fifth street, where it has been for the past six months erecting an addition to its plant.

THE SIMPLEX AIR BRAKE & MFG. CO., of Pittsburgh, have opened a Chicago office in the Railway Supply Permanent Exhibit, 900 Lytton building, with C. A. George in charge.

THE UNION FIBRE COMPANY, Winona, Minn., has moved its Chicago office from room 1613 Great Northern building to the Railway Exchange building.

The general offices of THE UNITED STATES LIGHT & HEATING COMPANY, at 30 Church street, New York City, will be moved on May 20, 1914, and located thereafter at the company's plant, Niagara Falls, New York. This transfer will result in bringing together the administrative, sales, engineering and production departments.

THE PANTASOTE COMPANY has moved its Chicago office from the Fisher building to the Peoples Gas building, 122 South Michigan avenue.

THE TAYLOR-WHARTON IRON & STEEL COMPANY, High Bridge, N. J., Wm. Wharton, Jr., & Company, Inc., Philadelphia, Pa., and the Tioga Steel & Iron Company, Philadelphia, Pa., have moved their Chicago office to 1880 Continental & Commercial Bank building.

THE TRACK MAINTAINER CO., of Memphis, Tenn., has placed an exhibit at the Railway Supply Permanent Exhibit, 900 Lytton building, which will be the Chicago headquarters of their representative, J. W. Dodge, Jr.

ARTHUR T. DAVIES and ARTHUR G. TOWNSEND have been appointed district sales managers at Chicago for the C. C. & E. P. Townsend Company, with offices in the Otis Building.

CHARLES P. WILLIAMS has severed his connection with the National Lock Washer Co.

W. T. KYLE has resigned his position with the Duplex Metals Company, Chester, Pa., and will engage in other duties.

EDWARD G. JOHNS has resigned as New York representative of the National Graphite Lubricator Company, Scranton, Pa.

THE OTLEY MFG. CO., of Chicago, Ill., has changed its name to the Otley Paint Mfg. Co. and has also increased its capital stock to commensurate with its increased volume of business.

THE GRAY SCREW & BOLT COMPANY has moved its Chicago office from 72 West Adams street to 1887-1889 Continental & Commercial National Bank Building.

THE TITAN STORAGE BATTERY COMPANY, of Newark, N. J., will take over the business of the Baltimore Storage Battery Company, of Baltimore, Md. The new company will continue under the same ownership and management as its predecessor.

EDWIN S. WOODS & CO., of Chicago, Ill., has moved to 1024-1028 McCormick building.

THE TRANSPORTATION UTILITIES CO., 30 Church street, New York, has acquired the business of the General Railway Supply Co., of Chicago.

O. S. FLATH has been appointed western representaive of the Maloney Oil & Manufacturing Company, Scranton, Pa., with office at 1257 Peoples Gas Bldg., Chicago, Ill.

QUINCY A. HALL, formerly engineer of tests of the Isthmian Canal Commission, is now secretary and engineer of tests with the Morgan T. Jones Company, Monadnock Block, Chicago.

E. L. POLLOCK has been appointed Chicago sales manager of the National Graphite Lubricator Company, Scranton, Pa., with offices in the McCormick Building, Chicago.

T. J. POWELL, formerly purchasing agent of the St. L. & S. F., has resigned to go with the Pierce Oil Corporation.

A. P. MONTAGUE has been appointed general manager of the Covington Machine Company, Covington, Va.

JAMES C. H. FERGUSON has severed his connection with the Midvale Steel Company, Philadelphia, Pa., to become Pacific coast representative of the William Cramp & Sons Ship & Engine Building Company, with office in the Monadnock Building, San Francisco.

FREDERICK T. CONNOR has been appointed western railway sales agent for the Carbon Steel Company of Pittsburgh, Pa., with offices at 819 Railway Exchange Building, Chicago. He was formerly with the Joliet Railway Supply Company.

JAMES C. BOYD has been elected vice-president of Westinghouse, Church, Kerr & Co.

ROBERT COLLETT, superintendent of locomotive operation of the St. Louis & San Francisco, has resigned to go with the Pierce Oil Corporation.

THE BINTLIFF SUPPLY CO. has recently been incorporated and is occupying the store at 409 N. Third St., St. Louis, Mo. This company is organized to manufacture a line of rail benders, track drills, track levels and track gauges and also represent several large eastern manufacturers, such as E. F. Houghton & Co., of Philadelphia, Lincoln-Williams Twist Drill Co., of Taunton, Mass., Massachusetts Saw Works, of Springfield, Mass., and others. The officers of the company are C. T. Jones, president; H. B. Bintliff, vice-president and treasurer, and J. F. Bartmen, secretary.

THE CONTINENTAL RAILWAY SUPPLY & EQUIPMENT CO., Chicago, has been incorporated with a capital of $300,000 to manufacture and market railroad equipment. The incorporators are Oglesby Allen, Jr., Joseph P. Williams and Thomas P. McDonough.

THE SOUTHERN LOCOMOTIVE VALVE GEAR CO., Knoxville, Tenn., has applied for a charter. The company is capitalized at $300,000.

F. A. SCHAFF, who has been connected with the Chicago office of the Locomotive Superheater Co., has been transferred to its New York office.

THE DEARBORN CHEMICAL CO. has transferred its southeastern branch office from Birmingham, Ala., to 1407 Vandler building, Atlanta, Ga., where C. H. Everett and J. F. Boutelle, representing the Dearborn company in that territory, will have their headquarters.

ORENSTIN-ARTHUR KOPPEL CO., have moved the general offices from Pittsburgh, Pa., to Koppel, Pa.

MUIR B. SNOW has been elected president and general manager of the Detroit Twist Drill Company, Detroit, Mich., succeeding his brother, Neil W. Snow, deceased.

EBERT J. FULLER has been appointed representative of the Hunt-Spiller Manufacturing Corporation, of Boston. Mr. Fuller was formerly with the Chicago & North Western.

THE L. S. BRACH SUPPLY COMPANY has moved its Chicago office from the Karpen building to the ninth floor of the Lytton building.

THE EHRET MAGNESIA MANUFACTURING COMPANY will move its Chicago office from 371 West Ontario street to the Gibbons building, 20 E. Jackson boulevard, on May 1st.

THE FOOTE-BURT COMPANY, Cleveland, Ohio, has opened an office at 436 Wells building, Milwaukee, Wis. Charles Gordon is in charge.

ISHAM RANDOLPH, consulting engineer, has moved his office to 1827 Continental & Commercial National Bank building, Chicago.

THE INGERSOLL-RAND COMPANY, New York, has opened a new branch office and warehouse in Los Angeles, Cal., at 1036 Union Oil building. W. A. Townsend, formerly manager of the company's El Paso office is in charge.

ALEXANDER B. SCULLY, president of the Scully Steel & Iron Co., died on May 7 at his home at Chicago. Mr. Scully was born November 29, 1856, and in 1875 entered the employ of Joseph T. Ryerson, remaining there until 1885. In 1886 he formed the W. S. Mallory Co., which firm sold out to Jas. T. Ryerson & Son in 1890. In 1891 he formed the Scully-Castle Co., which later became the Scully Steel & Iron Co., of which firm he was president until his death.

GEORGE M. CARPENTER, formerly chief locomotive fuel inspector of the Nashville, Chattanooga & St. Louis, has been appointed a special representative of the Arrow Boiler Compound Co. of St. Louis, Mo. His headquarters are at Nashville, Tenn.

WHITE ENAMEL REFRIGERATOR CO. SUCCESSFUL IN DAMAGE SUIT.

The White Enamel Refrigerator Co., St. Paul, has won a victory over the Seeger Refrigerator Co. in a case in which damages of $1,700,000 asked were whittled down to 6 cents, according to G. C. Bohn, president of the White Enamel Co. The battle over the patents on the siphon system of cooling refrigerator cars has been carried on in United States district courts for the past eight years.

The final suit was decided in New Jersey, where Judge Edward G. Bradford has handed down a decision in the suit brought by the Seeger Refrigerator Co. against the American Car & Foundry Co. to recover damages on the Bohn devices.

The damages were claimed because of the use of the Bohn Siphon device by the defendant company in the construction of 16,000 cars. Judge Bradford gives a decision in favor of the Seeger company and fixes the damages at the nominal sum of 6 cents.

Judge Bradford sets aside the Seeger patent in his decision as not to be considered. He says:

"The complainant is entitled to recover from the defendant a nominal sum of 6 cents, together with its costs in this suit, except such as are involved in the accounting, and the defendant is entitled to recover from the complainant its costs in the accounting."

In 1910 the United States circuit court for the Southern district of New York refused to grant an injunction against the use of the Bohn Siphon cooling device by the American Car & Foundry Co. Different phases of the same suit to protect the patent were heard in many courts since the action was begun eight years ago.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF THE RAILWAY MASTER MECHANIC, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

Railway Master Mechanic is published monthly at 431 South Dearborn St., Chicago, Ill.

The officers are as follows:
President—William E. Magraw, 431 So. Dearborn St., Chicago.
Editorial Director—L. F. Wilson, 431 So. Dearborn St., Chicago.
Editor—O. W. Middleton, 431 So. Dearborn St., Chicago.
Business Manager—C. C. Zimmerman, 431 So. Dearborn St., Chicago.
Publisher—The Railway List Co., 431 So. Dearborn St., Chicago.

Those holding stock to the amount of one per cent or more are as follows:
W. E. Magraw, 431 So. Dearborn St., Chicago.
C. S. Myers, 50 Church St., New York.
H. H. Schroyer, 38 So. Wabash Ave., Chicago.
A. R. Cosgrove, 50 Church St., New York.
C. A. Dunkleberg, Ft. Wayne, Ind.
E. C. Price, Springfield, Ohio.
H. U. Morton, 140 So. Dearborn St., Chicago.
J. S. Bonsall, 26 Cortlandt St., New York.
G. H. Williams, Rockefeller Bldg., Cleveland, Ohio.
P. S. Smith, 434 So. Green St., Chicago.
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L. F. Wilson, 431 Dearborn St., Chicago.
O. W. Middleton, 431 So. Dearborn St., Chicago.
B. H. Peck, 4904 No. Paulina St., Chicago.
Chas. Oliff, 831 So. Winchester Ave., Chicago.
J. E. Chisholm, Old Colony Bldg., Chicago.

Those holding bonds to the amount of one per cent or more are as follows:
W. F. Hall Printing Co., 446 W. Superior St., Chicago.
Cozzens & Beaton, 443 Plymouth Court, Chicago.
Bradner Smith & Co., 175 W. Monroe St., Chicago.
Harry C. Lewis, New York, N. Y.
Geo. H. Holt, 431 South Dearborn St., Chicago.
Myron C. Clark Publishing Co., 612 So. Dearborn St., Chicago.
Mrs. Jessy Hazleton, 446 W. Superior St., Chicago.

(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 31st day of March, 1914.
(Signed) Robert R. Grieg.
(My commission expires Oct. 26, 1915.) Notary Public.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Central Office: House Bldg., Pittsburgh, Pa.

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.
This Publication has a larger circulation than any other among mechanical department officers. Of this issue 5,200 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, June, 1914 No. 6

CONTENTS.

Valve Gear Design.

There are a number of valve gear designs in use which, it is said, do not give the best results because, first, the reverse shaft is located for full gear position, thus placing the engines out of square at running cut-off and, second, the link is given too much throw and has to be hooked back to get full valve travel, cutting down the effective throw of the reverse lever and reducing the range of cut-off that should be given.

The article in this issue on "Design and Adjustment of Walschaert Valve Gear" should benefit roads having such trouble, as it covers each step in the design and operation of a Walschaert gear very thoroughly. As the writer says, "Much has been written to show the advantages of this type of gear, dealing mostly with the construction from a repair standpoint. The designer, however, has had to rely upon his own knowledge in designing new gears or correcting defects in existing gears." The information contained in the article is so carefully and completely worked out that it should be an easy matter to work out designs from it. The writer has carefully tested out the principles which he has laid down by indicator tests and otherwise.

Powdered Coal

A locomotive engineer who has seen long service has the following to say with regard to engines which steam poorly:

"It is not always the quality of the coal that counts, but its condition when it is put on the tank of an engine. In many cases it is ground to dust when put on the tank, because of the way in which the coal is handled. Much of the coal which is run through crushers and carried up into large hoppers, from which it is let onto the tanks, is so ground up that a large amount of it is dust. Firing an engine with such coal causes a large amount of waste and the engine will not steam. I find that coal which is placed on an engine from coal chutes into which the coal has been unloaded from cars direct, by falling through grates, is nearly all in good condition. Considerably less of this sort of coal is necessary to do the work."

This is the viewpoint of a man who is taking on coal from different stations every day and who has been up against the proposition of getting his engine to steam with some of the coal that is furnished him.

The trestle type of coal chute is very much in favor with many railway mechanical men and a careful test undoubtedly would show that the coal handled by it is in better condition than that handled by mechanical plants. However, this type of coaling station in many cases is not feasible on account of lack of capacity, cost of ground, etc., and a mechanical plant is necessary. In installing such a station a number of points should be considered, such as the class and amount of power to be supplied, the character of the coal, the ground available, etc.

Certainly more attention should be paid to this subject in order that such conditions as the locomotive engineer describes above, should not prevail. It is not good economy to haul coal hundreds of miles and then put it into a coal chute which grinds it to dust, for a locomotive cannot operate efficiently on this sort of coal.

The Patent Laws of Our Country

Individual inventors, whose brains have in the past given birth to the inventions and improvements which have been of greatest benefit in American industrial progress, are not being accorded a square deal by the present patent laws of the United States. There is a growing sentiment among those who have been brought to a realization of this fact, that there should be a comprehensive revision. Large manufacturers are in a position to protect themselves under present laws and the unscrupulous among them find it a reasonably safe practice to infringe upon the patent rights of individuals in addition to the benefits derived through their own which their power and not that of the Government renders safe from infringement. Continued progress is dependent upon new inventions as it has been in the past. If the incentive to such invention by independent individuals is withdrawn by the lack of protection which the present laws are supposed to give, but which they do not give, inventive improvement will be retarded. By placing the burden of proof upon the invention in case of infringement the cost of obtaining proper protection is frequently prohibitive unless the case is prosecuted by persons with large financial resources and the more important the invention, the more difficult is its protection against infringement. Orville Wright is quoted to have said that it cost over two hundred thousand dollars to protect him in his important invention, although he was subsequently proved justified in his claims. It does not take an astute mind to realize the helplessness of the poor inventor in such a case.

A bill has been introduced in Congress by Chairman Oldfield of the Patent Committee, which is designed to remedy this condition. The bill provides for a royalty to be paid the patentee after he has simply proved that his claims have been infringed, pending legal decision as to whether the claims were properly granted. This will give the inventor funds to prosecute his case and will, if passed, serve to alleviate conditions to some extent. The bill or a stronger substitute should be passed.

Handling Scrap.

The handling and reclaiming of used materials is given careful attention and study on all of our railroads and although it cannot be said that any of the large systems are lax in this regard, it is sometimes the case that items are classed as reclaimed material when they do not properly come under that head. The accumulation of a large number of reclaimed parts are counted as that much saved regardless of whether they can be used by the road or not.

In an article of "Reclaiming of Material," published elsewhere in this issue, Mr. R. W. Burnett, general master car builder of the Canadian Pacific, brings out some interesting points along this line. He recommends that where certain materials show tendencies to accumulate, that the excess supply be scrapped, as it would not be just to include this excess supply in a statement of the savings effected. This point is well taken, for it is not a saving to accumulate parts which cannot be used.

The man in charge of the scrap dock at Angus shops, says Mr. Burnett, was for many years foreman of a large freight car repair shop. A great amount of reclaimed material comes from cars and the experience which a man would receive as foreman of a car repair shop, should make him a vary valuable man to take charge of reclaim work. A practical knowledge of what scrap material can be used should be one of the indispensable requirements of a scrap dock foreman.

Mr. Burnett's article also cites a number of cases where broken parts are repaired and in reality reclaimed although he considers that they should be considered as examples of shop kinks.

Standardization of Freight Cars.

A committee of seven railway presidents has been appointed by the American Railway Association to investigate the subject of car standardization. Action of this nature has been expected for a long time and its necessity was explained pointedly by E. P. Ripley, president of the Santa Fe System, in an article published in the *Railway Master Mechanic*, issue of September 1913. Mr. Ripley has been selected as one of the committee.

It has been argued by some who favor the movement that federal legislation will be necessary to bring about complete standardization. It would seem, however, that radical steps should be taken to anticipate and thus avoid such legislation, with its cumbersome red tape and inspection system. The Master Car Builders' Association has prepared the way for concerted action on the part of the railways and with the data secured by its committees the adoption of standardization rules through mutual agreement, with reasonable allowance of time for compliance, should not be attended by unsurmountable difficulties.

It is believed that the evils of present conditions are so thoroughly realized as to make 100 per cent co-operation assured.

Railway Club Membership.

Throughout the various sections of the country there are located a number of strong and well established railway clubs. Their membership is large, their monthly meetings well attended and their past records are ones to be proud of. The large majority of the members are men from the mechanical departments, and naturally the topics discussed deal largely with mechanical topics.

The value and necessity of mechanical department men getting together monthly is not to be questioned, but it does seem that more could be done to make these organizations more truly representative of the railway men in the various sections of the country, where the clubs are located. The admission of engineering department men to these organizations and the discussion of subjects of mutual interest would benefit both departments and would enable each to appreciate the viewpoint of the other. The organizations would be even stronger than at present and at the same time more truly railway clubs.

As we go to press, the indications are that the United States Government has at last acknowledged officially the injustice to the railways incident to the system, now practiced, of computing remuneration for the transportation of United States mail matter. The report of the committee on railway mail pay is a voluminous document, recommending a new method of computing by volume instead of by weight. The increase in the amount of compensation is from the present fifty-one million to sixty-one million dollars. Additional good news relates to the much discussed freight rate case. If, as authoritatively predicted at this writing, an increase approximating four per cent is allowed in a decision to be handed down on or about June 15, the month will be a happy one for every reader of this journal.

Twenty Years Ago This Month

(From the Files.)

The Master Car Builders' Association in convention at Saratoga was called to order on June 12 by President E. W. Grieves.

The American Railway Master Mechanics' Association, also in convention at Saratoga, was called to order June 18 by President John Hickey.

Prominent among those whose names appear as among those in attendance at the convention of 1894 are the following: E. D. Bronner, F. W. Brazier, G. W. Demarest, Wm. Garstang, John Kirby, J. J. Hennessey, C. A. Schroyer, J. F. Deems, A. W. Gibbs, Pulaski Leeds, J. H. Manning, Robt. Quayle, J. E. Sague, Samuel Vauclain, W. H. Marshall, E. B. Leigh, E. M. Bushnell, F. A. Barbey, E. E. Gold, O. P. Letchworth, E. M. Gould.

H. U. Mudge has been appointed general superintendent of the eastern grand division of the Atchison, Topeka & Sant Fe.

The great strike of the Pullman Co. employes at Pullman, Ill., is still in progress, with no prospect of settlement.

Mont Clare shops of the Baltimore & Ohio are closed.

A seamless copper tube 16 ft. long and 7 ft. in diameter by 5 millimeters thick was recently turned out by a Swiss firm.

Arrangements are being completed for the use of oil fuel on the Riga railway in Russia.

The heaviest mogul locomotive in the world was recently built for the Delaware, Susquehanna & Schuylkill Ry. It weighs 76 tons.

W. H. Owens has been appointed general master mechanic of the Richmond & Danville, with headquarters at Manchester, Va.

Floods in the Northwest were so serious that all traffic on the Great Northern, Northern Pacific and Canadian Pacific has been held up for two weeks.

The Baltimore & Ohio ran a special train from Baltimore to Chicago, June 23, in 19 hours and 46 minutes.

One of two locomotives of the Cleveland, Cincinnati, Chicago & St. Louis was recently rescued from the bottom of the Wabash river at Terre Haute after lying there nearly two years. The failure of a bridge span following a collision had dropped the two locomotives into the river and their removal was delayed on account of the difficulty of recovery. It was found that one of the engines was too deeply embedded in quick sand to recover, although after the first engine was lifted out a block and tackle was adjusted to the boiler head of the second. The boiler was pulled apart without effect. Later the frames were twisted out by a pull on a drive wheel, but still the engine could not be lifted from the mud and it was allowed to remain.

The United States Headlight Co. has been organized to take over the headlight patents and headlight business of M. M. Buck & Co., Dayton Mfg. Co., Kelly Lamp Co., Steam Gauge & Lamp Co., J. A. Williams & Co., and Adams & Westlake.

The Magnolia Anti-Friction Metal Co. made its first exhibit at the mechanical conventions this month.

THE PANAMA-PACIFIC Exposition, to be held at San Francisco in 1915, has constructed its own system of railways which cover every part of the 635 acres of the site. Upon the arrival of a train loaded with exhibits it will be sided onto this system and the freight cars hauled directly onto the exhibit palace for which the display is intended. Rails have been laid inside the buildings, so that it will be possible to have the car unloaded on the very spot which the exhibit will occupy.

Those exhibits arriving by ship will be transferred to trains and handled in the manner described in the foregoing paragraph.

Facilities for handling the exhibits at the Panama-Pacific Exposition are far better than has ever been the case at any former exhibit, it is said. The system for handling the exhibits was devised by experts, over three years ago.

RELATIONS BETWEEN SUPPLY DEPARTMENT AND OTHER DEPARTMENTS.

By M. K. Barnum General Mechanical Engineer, Baltimore & Ohio R. R.

Most of the larger railroads now have a separate supply department for the handling of material required for construction and maintenance work, but the organization and status of the supply department varies on different railroads. On some roads a vice-president has been appointed to take charge of the supplies for all departments, while on the majority of roads the purchasing agent is at the head of the supply department. There are other roads where the purchasing agent simply does the buying, and a general storekeeper has separate jurisdiction over the receiving, distributing and accounting for material.

On railroads which have a separate supply department the best results can only be obtained by thorough co-operation between the supply department and the mechanical, maintenance of way and transportation departments. There seems to be a tendency on roads, where there is a separate supply department, for the mechanical and maintenance of way departments to feel a lack of responsibility in the matter of keeping the general storekeeper fully advised as to their prospective needs, and also as to any responsibility for an excessive accumulation of stock. As a rule the average stock of staple articles should be kept up by the supply department without special request or requisitions from the departments which are to use the material, but in order that there may not be an excess of material over and above prospective needs the mechanical, maintenance of way and transportation departments should keep the general storekeeper and the division storekeepers fully advised of all unusual increases or decreases in the demand for supplies.

For all articles, other than staple supplies, the original requisitions should be approved by the master mechanic, division engineer or train master, according to whichever department is to use them, and in the case of tools and other articles which are special or unusually expensive the requistions should be approved by the head of the department by which they are required. On some roads the approving of requisitions comes to be a matter of routine, so that many of the signatures are perfunctory, and have little or no value so far as actually censuring the requisitions is concerned. This method tends to delay the handling of requisitions, and frequently results in carelessness in the ordering of supplies which are special, either in their character or quantity. For these reasons requisitions should, as a rule, be approved only by those who affix their personal signatures, and should not go to officials who delegate a chief clerk, or someone with even less practical experience, to sign the name of the superior official.

Shortage of material must necessarily occur at times, no matter how large or varied a stock is carried, but the department requiring material can do much to prevent such shortages by anticipating its needs sufficiently in advance, and by keeping the division storekeeper and general storekeeper fully advised as to the progress of the work for which the material is required. As a rule the master mechanic who works in closest touch with the division storekeeper is the one who least often is heard to complain about the shortage of material, while the master mechanic who is inclined to expect the stores department to have all kinds of supplies ready for his use at any and all times, without assuming any personal responsibility for the matter, will be found constantly complaining about shortages of material. Too much stress cannot be laid upon the importance of the master mechanic making visits daily, or oftener, when necessary, to the division storekeeper and keeping him fully informed as to the amount and kind of work that is on hand and in prospect. The same cooperation will tend to prevent the accumulation of a surplus of material over and above the requirements of the work. As a rule the officials of departments using material feel very little

responsibility for any surplus, and only complain when there is a shortage, but the division superintendent, master mechanic and division engineer should all feel a personal responsibility for a surplus of material as well as a shortage, as a surplus means an investment of capital which is bringing no return. For example, if a road has a surplus of $1,000,000 worth of material which is not required within a reasonable length of time it represents a loss of $50,000 per year at 5 per cent interest.

Every master mechanic should consider it his duty to frequently make a thorough inspection of all material carried on hand for the benefit of the mechanical department, and he should hold his various foremen responsible for watching the stock in which each one is chiefly interested. A lack of such close co-operation with the supply department often results in tracing for material which is actually in stock, or in excessive orders being placed to prevent complaints of shortage, either one of which is detrimental to the best interests of the railroad.

THE ROUNDHOUSE AND FUEL ECONOMY.

By J. S. Sheafe, M. M., B. & O. System.

Two general divisions may be recognized in the vast subject of fuel economy—roundhouse practice and road practice.

The roundhouse offers an easier field for effort in that it is within prescribed limits, or in other words, within the more efficient zone of observation. While fuel consumption on the road rests with the road foreman, the territory assigned to such official is so extensive that it is impossible for him to cover the whole question as well as might be desired.

Many road foremen have the blessing (it is no less) of inspiring enthusiasm among engine crews, and their set standards are well lived up to even in their absence. Why? No doubt because they have the necessary tact in going about their business. Some one has said: "Knowledge is weight; tact is momentum." There are, therefore, road foremen who have the tact to furnish the momentum which is always necessary in overcoming obstacles and arriving at desired results.

In making an effort towards effective fuel economy it appears more advantageous to take up the ends rather than the middle of the problem. As the locomotive fire begins and ends at the roundhouse, one would ordinarily expect this to be the place where most could be accomplished in a short time. And it is. An inspection of the cinder pit operations will show abuses which should not exist. An engine having delivered its train would have enough steam to reach the roundhouse, if conveniently located, without the addition of any coal. If there is any boiler work to be done, the engine crews should take engines in with the minimum fire.

There is a great waste of fuel in keeping up a heavy fire when the trip is ended and there is a tie-up at the roundhouse ahead. An engineer should take notice of this fact and instruct the fireman in putting in only enough fire to protect the engine against leaky flues, etc. The engine, if it is to have fire "knocked" out immediately should be left alone. If not immediately, there should be a small bank placed under the flue sheet.

If the loss of green and partially consumed coal at the cinder pit can be eliminated, a substantial start has been made in fuel economy. Is it possible to enlist the coöperation of the engineers and firemen? We believe that it is if the matter is presented to them in the right way.

If the engine arrives at the roundhouse with the fire in proper condition, there will be no green and partially consumed coal in the cinder pit, the fire cleaners will not be suffocated by the hot gases and everyone will feel that there has been no more coal put into the firebox, after arrival at terminal, than was absolutely necessary.

Engine crews will no doubt require considerable checking up until they understand the necessity for care, because they are like the rest of the human family, not so interested until bills are paid out of the individual pocket.

If an engine is to be kept hot during its layover, or if the engineer is uncertain whether the fire is to be cleaned, the bank should be only sufficiently large to protect the fire. If the coal is all in one place it will require less attention, it will burn less weight and is easily available for spreading in getting engine hot. There is a vast deal too much grate area made use of in keeping up engine fires.

It may be assumed that the hostler on duty has direct charge of the fire cleaners. If he has, it follows that with his coöperation started, good will soon follow. His duties keep him in touch with all that is going on. The preparation and care of the fire which is to be kept alive is the cause which precedes the effect of a large part of fuel waste for any one division.

There can be no logical reason advanced for the maintaining of the fire over the whole firebox. If a bank is kept under the flue sheet it can be quickly spread over the whole grate area if necessary. Eliminating the question of fuel economy, there is not the necessity for the water tender repeatedly putting on the injector to stop the periodical blowing off of the pops.

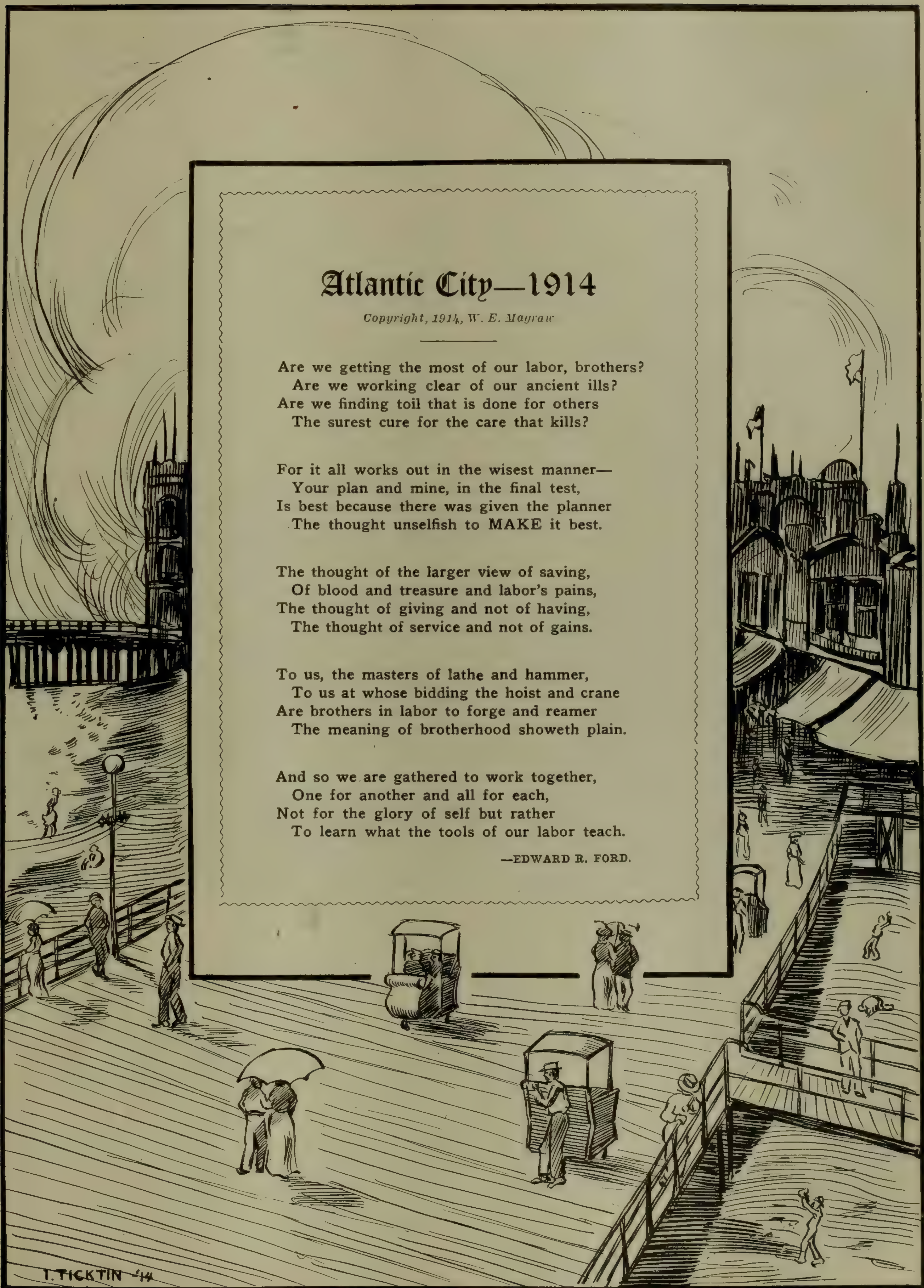
The air pump should be shut off as soon as an engine arrives at the pit, both for the sake of the flues and so as to keep cinders out of the intake. The blower, much abused device, should be "cracked" slightly. Probably, in 95 per cent of the fires cleaned, the blower is opened far beyond the point necessary. A small effort will stop this abuse. After the fire is "knocked" a good hostler will handle the throttle very carefully and will put the engine away with the air stored up in the main reservoir and without working the pump. He cannot always do it, unless economical in the use of air. If the engine is put away properly a good showing will be made in the roundhouse boiler work.

Quite as important is the firing up and delivery of engines. In the former case, the fireman, with his dirty and excessive fire works a hardship on the fire cleaners. Now they can, by improper preparation, get it all back, not only on the engine crew, but on everyone else within a great radius of the roundhouse. An engine should be fired up in just sufficient time to protect the run, no more and no less.

If the boiler has been washed out, more time is necessary to insure the blow-off cocks being tight under steam. If water shows in the glass, or lowest gauge cock it is sufficient, as when this becomes heated it will expand and be well within the safe limit. It is necessary, except in hurry cases, to have some leeway to prevent popping off afterward. With a full boiler there is no chance to avoid this nuisance. In turning on the shop blower after the fire is lighted, it should also be throttled to a point where there is a draft without the pulling effect of a wide open valve. Any other practice soon opens holes in a fire and afterwards any draft is almost valueless. A locomotive fire, built up under the action of the blower has usually little body and means lots of work for the fireman. The best fire and the cheapest is the solid one started under a very light blower and afterwards built up without any more draft than enough to keep the smoke from coming out into the cab. This is the fire that will keep the steam guage needle at the right angle during the beginning of the trip.

If the crew takes an engine with enough steam pressure to properly work the air pump and go to the yard for their train, there will ordinarily be plenty of time in which to make everything ready for the start. There will be no popping off, and if there is, the supply of water in the boiler can be added to without flooding it. With a quickly prepared blower fire many an extra scoopful of coal is burned in getting it into "workable" shape.

The flue borer needs checking up. Here, indeed, is an abuse. He sometimes merely jabs the augar a foot beyond the flue sheet and scratches off the work book. The engineer keeps reporting the work, but can see no improvement. Fire cleaners should appreciate a proper fire being delivered to roundhouse. Engine crews should appreciate a proper fire being delivered to them. Then why do they not work together a little closer?



Atlantic City—1914

Are we getting the most of our labor, brothers?
  Are we working clear of our ancient ills?
Are we finding toil that is done for others
  The surest cure for the care that kills?

For it all works out in the wisest manner—
  Your plan and mine, in the final test,
Is best because there was given the planner
  The thought unselfish to MAKE it best.

The thought of the larger view of saving,
  Of blood and treasure and labor's pains,
The thought of giving and not of having,
  The thought of service and not of gains.

To us, the masters of lathe and hammer,
  To us at whose bidding the hoist and crane
Are brothers in labor to forge and reamer
  The meaning of brotherhood showeth plain.

And so we are gathered to work together,
  One for another and all for each,
Not for the glory of self but rather
  To learn what the tools of our labor teach.

—EDWARD R. FORD.

MECHANICAL FIRING ON LOCOMOTIVES

It is needless to remind anyone of the great development of the steam locomotive in late years, since evidence of the changes wrought is palpable to all. Not everyone realizes, however, that abroad the development has been on an even more impressive scale than here. This has been especially the case in America, because there questions of the first importance have had to be faced owing to the bearing which the subject had on labor and other matters. We do not propose to embark upon a discussion of the way labor has been affected, except to make one or two comments on arbitration awards recently given in America. Both the drivers and the firemen have claimed material increase of pay on the plea that the larger engines now common entail greater labor on their part than formerly. The arbitration award in the case of the firemen, while leaving undefined the important question as to when a second fireman became necessary, has also made it possible for a fireman whose labors are light to be paid more than one whose work is heavy.

The scale of pay adopted in the award delivered in the firemen's case was based on a classification of locomotives according to the weight on the coupled or driving wheels. Though a workable system, this cannot claim to be very scientific, or be said to result in pay in proportion to effort. With us such a system would be more reasonable than in America, since here the range of work demanded of firemen as a class is smaller than there, owing to well-known limitations having a much greater restrictive influence here on practice and design. We have not reached, nor are we likely to reach, the limit of human ability in locomotive firing, but in America the locomotive boilers and grate areas attain sometimes to such dimensions that, on sustained runs, it is beyond the power of one man to keep up steam throughout the trip without assistance. An extra man then becomes necessary, and as a third man in the cab is objectionable from the point of view of discipline and economy, this question of extra help is of more than ordinary importance. When, as often is the case, the very large engines are used for comparatively short runs at maximum power, the work, though arduous while it lasts, is not severe taken over the hours of duty, and one man may suffice. This is the case in much "pusher" or banking work, but there are many "road" engines which undoubtedly tax the fireman's powers heavily.

A man may shovel about 5,000 pounds of coal, or something more, into a fire-box per hour, but he will not do very much more. Many American engines have grate areas of between 50 square feet and 60 square feet, ignoring special types, which are outside the present discussion. A rate of coal consumption of 100 pounds per square foot of grate per hour is often exceeded, and if the work be continuous the fireman will be taxed to the utmost of his ability to keep a full head of steam. The award we have referred to endeavored to take account of this demand on the men, but could only provide one general schedule by ignoring special cases. This has resulted in the failure to make any allowances for advances, past or prospective, in what Americans are pleased to term "the art."

A modern locomotive, though much heavier than its predecessors, and taking heavier loads, may entail far less labor on the part of the fireman, for many reasons. The engine may be more economical in itself, or it may be fitted with appliances which relieve the fireman of practically all effort. Of this the award takes no account. The large engine is taxed with high wages just because it is large. Nowadays many engines are fitted with superheaters, others are arranged for oil-firing, and others again with mechanical stokers. These and other improvements influence materially the work of the fireman. The majority of the arbitration court deciding the firemen's case, like Gallio, cared for none of those things. The basis of rating adopted, of weight on the driving wheels, treats them with indifference.

In view of the fireman problem in connection with large units of power, mechanical stoking would be expected to become a possibility in the United States earlier than here, where no such questions have arisen. What may happen in the future it is difficult to say. It may be that mechanical firing on some hitherto unthought of line may be adopted here for reasons of economy; there certainly is not any urgent need for it here yet, unless some very strong claims in this direction can be advanced in its favor. In America the matter has been approached from two or three points of view, and can now fairly be said to have been brought into the practical region of development. It has been attacked with a view to securing more economical firing than is usual for firing grates too large to be fired by hand, and also for firing at a rate above that possible by hand on grates ordinarily within the fireman's power. Nothing very definite has been proved so far with regard to the economy of stoker-firing. In some instances figures are advanced showing stoker-fired boilers to consume less fuel than hand-fired; in others the balance has just been turned the other way. In some cases an inferior and cheap coal unsuited to hand-firing has proved satisfactory with the machine, thus introducing a saving. Where coal is small and friable, the firehole door being kept closed, as in the stoker-fired engine, the loss in unburnt coal is probably less, while the fire-box temperatures are better maintained, two points conducive to economy.

The stoker will have an important bearing in the future on the handling of very large road engines, since it will abolish the need for an extra fireman. An equally, if not more important, direction in which it will prove of value is that of enabling heavier loads to be handled by forcing engines to higher rates of firing than is possible by hand. The Pennsylvania Railroad has gone into this aspect of the case very thoroughly, not only on its testing plant at Altoona, but also in service. At Altoona one of the largest locomotives in the United States, of the 4-6-2 type, was tested some time since, fired with a mechanical stoker. The rate of coal fired in these tests ranged from 2,074 pounds per hour to 9,600 pounds per hour on an effective grate area of 58 square feet. The higher rate is far beyond the capabilities of any fireman for continuous duty. The evaporation was well maintained, though naturally at some loss of efficiency. At normal rates the stoker gave about as good results as the most skillful hand-firing, but by rendering feasible rates of firing not otherwise possible it increases the range of work of which this class of engine is capable.—*Engineering of London.*

CORRESPONDENCE.

Editor, *Railway Master Mechanic*:

I have read with much interest the article on "Purification of Water for Locomotives," by Mr. La Bach, appearing in "*Railway Master Mechanic*" for May. The writer has succeeded in giving a very clear and concise account of the entire subject.

The summary of the properties of various inorganic impurities found in water is especially good, while the table of the reactions of water treatment will be found of great convenience to students of the subjects. The treatment of the subject of corrosion will do much to clear up this confusing phase of the use of water in boilers.

The treatment of priming and foaming is a little disappointing. The quotation defining these two terms is taken from a well known text on water treatment, but is not sufficiently clear to exert much influence in overcoming the popular habit of using these two terms as absolute synonyms. Had space permitted, a more complete discussion would have seemed desirable on the use of treated water in boilers, covering briefly the same ground treated so thoroughly by Mr. Pownall before the Western Railway Club some years ago.

It is to be noted that the writer agrees with the recent report of the water service committee of the American Railway Engineering Association, that it is at present impossible to determine the economy of water treatment with any degree of accuracy. It is to be hoped that the missing data may some day be made available, for the accurate statement of the economy of water softeners will result in extensive developments in this line.

W. S. LACHER.

Member Water Service Committee, American Railway Engineering Association.

Reclaiming of Material

By R. W. Burnett, G. M. C. B., Canadian Pacific Railway

The reclaiming of material and handling of scrap on railways is a matter of great importance. The various times that this has been written up shows evidence of careful thought, but there seems to be a marked difference in the methods of handling this important item.

In some of the articles on this subject credit is apparently claimed for reclaiming such items as wheel centers and couplers, which were never intended to be discarded, unless it was decided to discontinue the use of particular kinds owing to the change of design or increase in capacity of equipment making conditions such that part or all of such items became obsolete.

One mistake that the writer considers is made by some is too elaborate a system of records, but a poor system of keeping the amount of second-hand material to a minimum.

Reclaim Yard and Shop, Angus Shops, Canadian Pacific Ry.

Many statements of savings made are based largely on the amount of material picked out and piled up, when often only a small part of this material is used, the majority being finally scrapped, due to the quantity being in excess of requirements.

The tendency of certain material to accumulate should indicate that the supply is in excess of demand or that instructions relative to use of same have not been made clear or are not being followed up. The excess should immediately be scrapped if place for its use cannot be promptly found and a maximum amount to be held decided on, subject always to change as conditions vary.

Considerable saving has been made by most roads which follow up closely the reclaiming of material, but to show a money value for what has been saved is misleading as well as unnecessary. The most important part of this work is to prevent any good material from being sold or turned over to the foundry as scrap. With a system that prevents any good material getting into the scrap the Canadian Pacific feels that it has overcome the greatest obstacle in the way of the successful handling of this work.

The grey iron foundry and the wheel foundry which are located at Angus shops, and for which the scrap must be sorted, make it possible to pick out all good material with the one operation of sorting, thus entailing very little additional expense. Carload lots of scrap sent from outside points and properly sorted are unloaded under the supervision of the scrap dock foreman, so that the chances are slight of any good material getting into the cupolas.

As the handling of scrap is most centralized at Angus this article will principally deal with that point. The man in charge of the scrap dock was for many years a foreman in charge of an important freight car repair shop and is therefore thoroughly trained as to what is practicable in the use of second hand material.

For conveying of material to its proper place standard gauge tracks are used, one track being located in the center of the yard, and one on each side. The center track is used for the loading of reclaimed material for the stores and the incoming material is unloaded from the side tracks.

To simplify both labor and supervision of sorting material bins are provided for smaller pieces, as shown in the illustration. These bins are provided with covers in the winter, hinged at the center and propped open during the day and closed at night to keep the snow out.

Only one kind of material is to be kept in each bin, which makes the sorting of material automatic and makes possible the use of the most common labor with a minimum of supervision, as any man can be taught to throw material into a bin containing the same kind of material. Larger material, such as bolsters, couplers and brake beams, are piled on the ground.

The demand for some material is so governed by conditions

and change of policy that no set rule can be made covering the amount to be held. For instance, on a certain class of car it will be necessary one year to purchase or manufacture some repair parts, while the next year a policy may be decided upon to commence retiring this equipment, which would mean that large quantities of material that a short time before were being purchased or manufactured would be scrapped on account of being in excess of requirements. To take care of this feature and avoid an unnecessary accumulation, at frequent intervals a committee, usually two of the staff of general inspectors, makes a study of the material in connection with the scrap dock foreman and decides on kind of material and quantities to be held and scrap material found to be in excess of requirements. The procedure is to immediately remove such material from the reclaimed stock.

In the building of new equipment it sometimes happens that certain items do not arrive in time to be used on the order for which intended, making it necessary to substitute the nearest available size or purchase material locally, with the result that some material is left on hand after the order is completed. In designing of equipment this left-over material, together with second hand material, is taken into consideration and a design made to as far as possible contemplate its use. To assist the drawing room in using up such material the shop makes a monthly statement of such surplus stock. In handling of second hand material no book entry whatever is made of reclaimed material except when issued to fill requisitions, and excepting that a monthly statement is made of various items held and copies sent to various storekeepers and foremen. These statements are only estimates of quantities with the exception of such items as couplers and bolsters, which are easily counted. They are not checked for accuracy, but are only intended to advise that approximate quantities of various material is available.

As the quantities of second hand material change daily it is arranged that the stores will, before placing on purchase or to be manufactured at the shops any material that there is a possibility of supplying second hand, have a man visit the

Repaired Diaphragms.

scrap dock and consult the foreman. The foundry foreman and the blacksmith foreman are also required to visit the scrap dock at sufficiently frequent intervals to make certain that they are not manufacturing material that could be supplied from second hand, and likewise the scrap dock foreman is required to visit the foundry and blacksmith shop to see that material is not being manufactured unnecessarily.

The scrap dock at Angus shops is well provided with tools to handle the necessary repair work done in this department. Two long stroke air hammers are used to strip bolsters, as

Air Hammers for Stripping Bolsters, C. P. R.

Broken Hose Couplings.

Repaired Hose Couplings.

shown in the illustration, and one is used to strip brake beams. Coupler pockets are removed under a drop. This practice may not appeal to some who use a steam hammer or a special machine for this purpose, but there is no damage to the coupler or pocket with this method, and the cost of operation is far less than could be had with either a special machine or steam hammer.

The work of straightening and assembling bolsters and brake beams and fitting pockets to couplers, as well as other miscellaneous repair work, is done in a small shop which is located centrally in the reclaim yard. This shop is equipped with a brake beam straightening machine, a punch, a large face plate, one large oil furnace, one small furnace and necessary air machines for drilling.

The repairing of brake beams and fitting up of couplers with pockets are strictly items of shop repairs and should not be considered as material reclaimed, but these items interfere greatly with the regular shop work when done in the blacksmith shop and can be repaired at the scrap dock much cheaper and with a minimum amount of handling, for this class of material is generally shipped in from outside points with the scrap.

There are a number of important items reclaimed in the shops that have no connection with the scrap dock, and while this material is actually reclaimed it could also come under the heading of "good shop practice" or "shop kinks."

Vestibule diaphragms were found to be a big item of expense and were being renewed on account of the bottom portion tearing away. Instead of entirely renewing the diaphragm, the defective portion is now being cut away to the standard height of 24 inches and replaced by an "extension leg" piece, which has greatly reduced the maintenance cost of the diaphragms (see illustration).

Air and signal hose couplings formerly were scrapped when the lug which holds the guide pin was broken. These are now being repaired by drilling necessary holes and applying a new pin, as shown in the illustration. The saving on this item is obvious.

The shanks of worn out taps are used for making punches, which reduces to a minimum the purchase of new punches. Further economy is also made in this item in reducing to the next smaller size all worn punches.

Very few bolt threading dies larger than ⅝" are bought, as small sizes when worn out are bored out to the next larger size, and with the large bolt output at these shops this item of saving is an important one.

In the building of steel frame box cars, which have the ½" longitudinal side sheathing and 1¾" end sheathing, it was found that a certain amount of this lumber was spoiled in the kilns and more of it was spoiled in the handling. With the building of new equipment the supply of this defective lumber was steady. This material is used to reinforce the ends of the wooden box cars, for which purpose it could be used without any additional expense in the wood mill to work it over.

The additional end lining is not applied to use up this material, but we buy large quantities of decking to use for this purpose, so that the amount of culls used reduces our purchase by that amount.

In the application of steel center sills to the older equipment the discarded wooden draft timbers and deadwoods are turned over to the stores and are used to fill orders for this material for use at outside repair points, no new material being made up while any of the discarded material is available.

Passenger car steps of the wooden type are replaced with steel steps when one or more are defective, the remaining good steps are used up on renewals for running repair work.

The reclaiming of material in shop practice is usually followed closely in most shops, and the writer would like to see more items follow on this subject.

MAKING GOOD.

The successful conduct and development of the railway industry requires the services of thousands of men who are chosen for their fitness for the positions to be filled.

And in proportion to a man's fitness is his career. If a trial proves him to be unfit, he is dropped. If he proves his fitness for a higher post, he gets it in due course.

The opportunities in the railway field are practically without limit. Given a normal brain and the desire and energy to develop it, there is no position to which a man in the ranks may not rise.

It is necessary to the progress of the railway industry that men in the ranks should rise. The industry is not a thing of today alone. Means of transportation will always be in demand and the man most fit will be the man who will lead in supplying the demand.

But first, before he can become a leader, he must acquire the one habit that is characteristic of all leaders—the habit of making good. And making good does not mean doing your work so that it will "get by." Your work must be done so that it will not only get by, but that it will not "come back."

Learn your work, strive to improve the methods by which it is done. Study the men above you and their methods. Work, develop your mind, take care of your health, be honest with all men and particularly with yourself, and you will become one of those who have the habit of making good.

—*Brill Magazine.*

PROPER METHOD OF PACKING AND LUBRICATING JOURNALS.*

By G. J. Charlton, General Foreman, Car Department, D., L. & W. R. R.

The proper method of packing and lubricating journals means that labor and material should be so expended that the boxes once properly attended to continue to perform the work expected of them without bringing about the condition known as hot box. I will endeavor to show how this important work should be done, keeping in mind a maximum of efficiency and a minimum of expense.

I will commence by outlining the condition of the packing, that is, the quality of the ingredients, the waste and the oil. The waste should be wool, good quality, such as D., L. & W. specification No. 34-B, and entirely free from grit or dirt. This does not merely mean the dirt or grit getting into it during the process of preparation for packing, but also covers any objectionable material that is at times found in the waste as furnished from the market, such as needles and other items of foreign substance which may not be very readily observed but which contribute their quota to bring about a hot box.

The oil used should be the Galena Standard, and in the preparation of packing care should be exercised to see that the quality prescribed for summer or winter season is used accordingly, as failure to observe this on the change of season is bound to induce trouble. This is all a matter of common sense —the lighter oil being used in cold weather, when its density is increased, and produces the same condition as the heavier grade in the warm weather, the weather conditions in both instances acting as an agency of proper distribution and assisting in maintaining the proper percentage of oil in the waste over the entire journal box, thus preventing the sudden descent of the oil to a point below that of lubrication.

The waste and oil should be mixed in the proportion of 80 pounds of waste to 90 gallons of oil. This to insure a thorough saturation of the waste. This mixture stands 48 hours in a room of even temperature of 68 to 70 degrees, after which 50 gallons are drawn off, leaving the ingredients in the following proportion: One gallon of oil to two pounds of waste or four pints of oil to one pound of waste. These proportions may appear somewhat dry, but my experience is that it brings the best results both from an economical standpoint and that of efficiency. A larger amount of oil is simply useless, as the mixture prescribed above produces the proper lubrication.

I will now describe the proper method of packing journal boxes, and first of all I will outline the entire repacking, such as on cars passing through shops or over repair tracks, and which is quite different to the attention given to loaded cars lined up for train movement.

Remove all the packing from the journal box and clean out the box thoroughly, leaving no particles of grit or dirt. All packing is removed, to be taken to reclaiming plant and worked over, as will be explained later. Then take a handful of new packing and twisting same form it in the shape of a rope so that it fits in the back of the journal box and forms a dust guard as well as a filler. Proceed to fill the box to the center line of the length of the journal, the centering hole in the end of the journal serving as a guide to the proper height, keeping the packing inside of the journal collar and seeing to it that the box is not too tightly packed. Place one piece of packing in front of the journal as a wedge, to keep the packing on the sides in place. This must have no connections with the packing on the sides or under the journal. See that no loose ends of packing hang from the box, as these will draw the oil from the box.

I have said to fill the box to center of journal, and this is most important, as packing laying above that point is apt to be caught and drawn between the journal and the bearing, producing friction, which results in numerous hot boxes on account of its action in hardening the material in the journal bearing.

A box thus packed is now ready for six months' service, providing it is not robbed on sidings, etc. In being placed in train service for trips of four hundred miles or so the boxes should receive treatment as follows:

Adjust the packing, removing any from the side of the journal that may have become dry and unserviceable, and bring the well saturated packing from the bottom of the box up to the journal. Be careful that the packing on both sides of the journal is not beyond the proper limit of height and is all on the inside of the journal collar. The packing removed from the sides of the journal above mentioned, or some of it, may now be replaced in front of the journal as a wedge and must have no connection with the packing under the journal.

This system if closely followed will produce satisfactory results and reduce hot boxes to a minimum, but of course circumstances over which we have no control or at least very little control will always be the cause of more or less trouble along these lines. Of these I will speak later.

Right here let me show the conditions taken from actual reports on the Buffalo division of the D., L. & W. R. R. for thirty consecutive days: Total number of hot boxes, foreign equipment, 82.7%; D., L. & W. R. R., 17.3%. This shows a favorable condition on D., L. & W. equipment, and let me add that of the foreign equipment representing the hot boxes there was a noticeable absence of cars belonging to any of the railroad lines centering at Buffalo.

Running over a longer period and comparing the number of hot boxes with the mileage made on freight trains, we have for the year ending October 31, 1913, a total mileage of 272,388,146 miles and a total number of hot boxes of 5,274, or a mileage of 51,837 miles for one hot box. For the same time we show a passenger mileage of 43,165,465, and a total of 79 hot boxes, or a mileage of 546,398 miles for one hot box.

The reclaiming of the packing removed is done by pressing out the oil, picking over the packing, removing as much dirt and grit as possible, then placing in reclaim tank, where it is steamed for twelve hours to further remove all dirt and grit and restore the elasticity. It is then pressed and mixed as follows: Two hundred pounds of old packing and 40 pounds of new waste, saturated with 70 gallons of oil, are allowed to stand 24 hours, after which 50 gallons of oil are drawn off, leaving the reclaim to consist of 10 gallons of oil to 120 pounds of waste. This makes a packing entirely satisfactory and equal to new. From an economical standpoint it well repays for the outlay of labor attendant to its preparation.

Let me call attention to certain other things which come in immediate relation to the proper method of packing and which if closely observed will serve to continue the proper condition of the packing and assist in the elimination of the hot boxes. I refer to the dust guard, which should be watched carefully and maintained in normal condition. The journal box lid should be in place and the fitting and tension of the same maintained by whatever springs or mechanical device intended. This will prevent as far as possible dirt from entering either the front or back of box.

Certain causes of hot boxes, such as hard roadbed, low and high joints, can not be traced to lack of lubrication. High and low joints cause trouble in boxes which have not been treated for some time and the packing having become soggy will not return to its former position in the box after being pushed down by the action of the journal.

Care should be taken in renewing journal bearings to see that they fit the journal, or in other words, that they have proper crown bearing. Journal wedge should also fit bearing properly—not too tight, in which case it would pinch the bearing to the journal, causing the edges of the journal bearing to absolutely prevent the entire lubrication, and not too loose, per-

*A paper delivered before the Niagara Frontier Car Men's Association.

mitting all-crown bearing, causing a tendency to break the journal bearing by concentration of weight to the crown.

One main factor that should be kept in mind is the great care to be taken in the changing of wheels on repair or shop tracks, more especially on high class of freight, as these cars are intended for fast movement and hot boxes on them involving delays invite more than ordinary criticism. It has come to the attention of the writer that the number of cars heating immediately after such work could be brought down to a minimum if special and proper care was given at the time of doing the work to see to it that the boxes were properly packed. At the present time when piece work is predominant and the money earned the chief object in view, this feature cannot be brought too strongly to the attention of the foremen and others in charge of such work.

No wiping of the journal bearing with waste for the purpose of lubricating it should be permitted, but instead squeeze some oil from the packing on the part and work over the surface with the hand. This will prevent any strings of waste from fastening to the journal bearing, which would have the same effect as allowing the journal box to be packed to a height beyond the center of the journal.

In the handling of wheels for shipment to and from the wheel press, and in fact from the supply track to the car under which they are to be used and also the removal therefrom, the men engaged should be instructed to see that the journals do not become marred or dented during such movement. This is quite apt to occur and the condition brought about in this manner may be totally unobserved. This condition would be a great source of hot boxes.

The filled journal bearing must not escape our attention. I realize the efforts that have been made by the master car builders to eliminate them, and not the least reason for doing so is the fact that it is impossible for the car inspector to ascertain or even to have a reasonable knowledge from the exposed end of the bearing to what extent they are worn, nor is it possible in any reasonable manner for the inspector to decide that the bearing is filled or a solid one.

Of the hot boxes developing on freight trains on the line of the D., L. & W. R. R. between Buffalo and Birmingham during the month of April, 55 were caused by filled journal bearings on foreign equipment. This number will be appreciated when we consider the very few lines using these journal bearings at the present time, showing that a large percentage of them develop hot boxes.

TESTING AIR HOSE COUPLINGS.

By Frank J. Borer, Fmn. Air Brake Dept., Cent. R. R. of N. J.

It is often hard to determine the condition of second-hand steam hose couplers prior to mounting them on new hose. The gravity relief traps of the Gold type of steam hose couplers after being in use for a whole season or two should be examined as to their condition before mounting the couplings on new steam hose again. To save time in testing these couplings I have constructed the device shown in the sketch, by means of which steam couplings can be quickly tested and the defects noted.

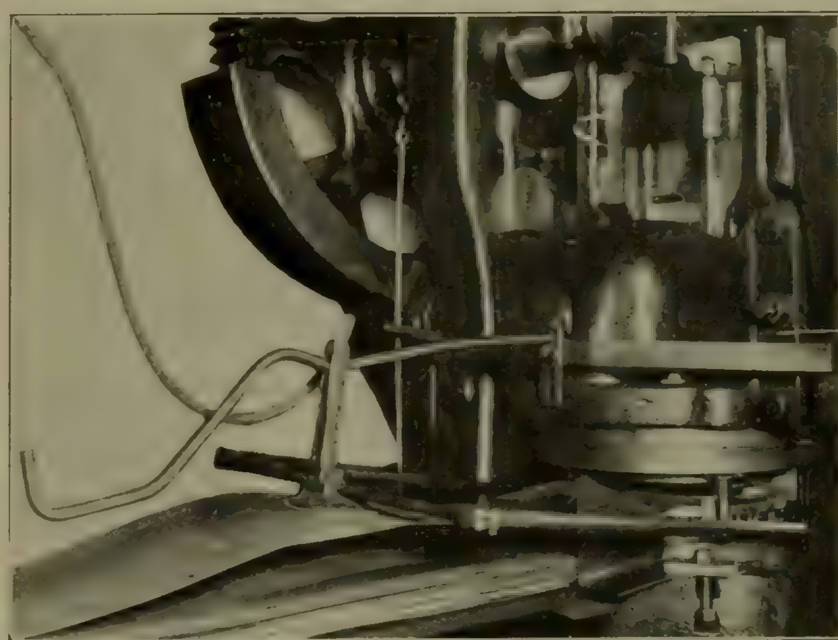
The device is made up from parts of a second-hand 2-inch globe valve, together with a U clamp and two straps. The U clamp is made to fit snug around the neck of the nipple near the base and the two iron straps are riveted to the clamp. The other ends of the straps are riveted to the valve bonnet. The valve bonnet is used only as a steam nut and is reduced in size to suit. Air hose couplings and nipples can also be tested by this device.

It is impractical to mount a new hose on a fitting of which there is an uncertainty as to its condition. When a hose is once mounted and it becomes necessary to remove a fitting on account of a defect the hose will always be more or less damaged, if not ruined, in the operation of pulling out the fittings, no matter how careful the hose man may be. It is therefore important that all steam and air hose couplings and nipples concerning which there is any doubt as to defects which would render them useless or which could not be repaired after the hose was mounted, be first tested and if found defective be either repaired or scrapped, as the case may be.

VACUUM LIFTING DEVICE.

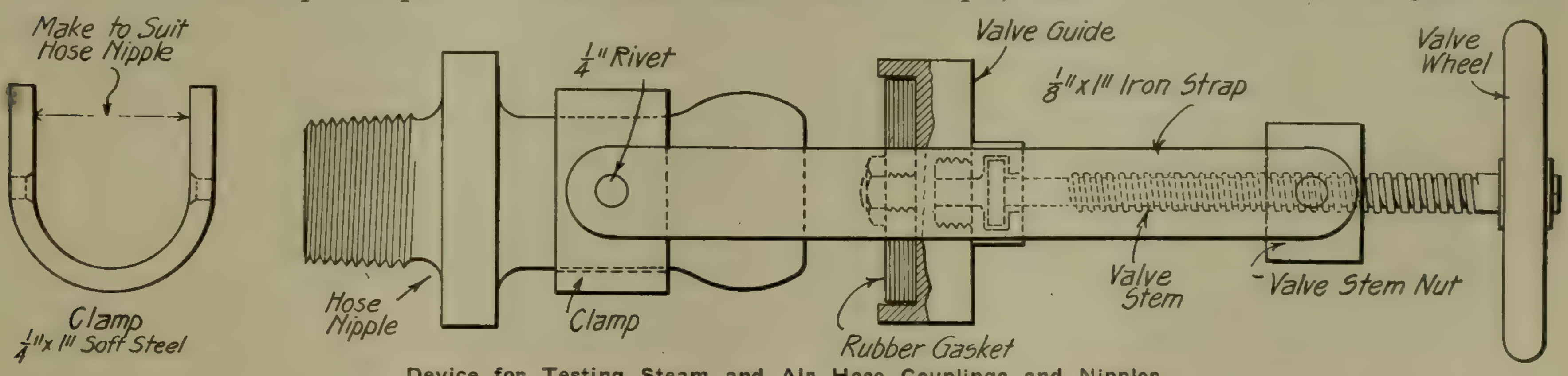
The vacuum lifting device shown in the illustrations enables the operators of a punch press to dispense with the helper, and at the same time all danger to the hands is removed.

As will be seen, it is an exceedingly simple affair, consisting of a "sucker" or lifting device about 8 inches in diameter which is connected by means of a rubber hose to a suitable suction line and which is further free to move on an irregularly shaped rod, its length of travel being controlled by the press hand through the medium of two guide arms or handles, one on either side of the punch and die; that is, just inside of the press housings.



Mechanical Vacuum Lifting Device.

The method of operation is as follows: A pile of metal sheets being placed in the rear of the press preparatory to being punched, the press hand on the opposite side of the press pushes the guide arms through the press towards the pile. The irregularly shaped rod allows the "sucker" to drop down until it rests on the top sheet of the pile, when a lever on one of the two guide arms is



Device for Testing Steam and Air Hose Couplings and Nipples.

Hand Suction Device.

then pressed, thus opening the suction valve and causing the "sucker" to grip the sheet of metal. The guide arms and the suction lever are not released until after the first blank has been punched. By thus retaining hold of the guide arms, practically all danger of injury to the hands is removed, for in punching the succeeding blanks, the operator can almost invariably pull the sheet forward by means of the scrap or margin.

Another illustration shows the operation of a hand suction device about three inches in diameter which operates on the same principle described above. These devices are in use at the works of the Westinghouse companies.

A THRESHING MACHINE MACHINIST.

By Frank Phelps.

Several years ago when I was learning the machinist trade in one of the Pennsylvania railroad shops, we rebuilt one of the largest and most powerful passenger engines on our division of the road. As I was only an apprentice at that time, I was detailed to help a machinist by the name of Nate Wright in putting up the links, eccentric and rods on the engine.

The engine had been given a new main axle, and the job included setting the eccentrics in their proper places and then cutting the key-ways and fitting the new keys in all four of the eccentrics.

We had as our gang foreman an ex-master mechanic, who had lost out on his job as master mechanic on account of John Barleycorn. He was a first class mechanic for that time, however. After the wheels had been put under the boiler and trammed up, and the pedestal braces bolted in place, the foreman got down in the pit under the engine and showed Nate just how to place the eccentrics, one above the axle and the other below. As the main pin on the right side was on the front center, the foreman showed Nate how to advance each eccentric on the axle so as to help give the valves the proper amount of lead, when the engine would be running either forward or backward. I was somewhat surprised at the foreman giving instruction to Wright, and I learned later that Nate had served his time in a shop where they built threshing machine engines with only one eccentric and that a direct action one.

We went to work and in due time had the right side up in good shape. When we had finished it the foreman took a look at it and was well pleased with our work. After examining it he told Nate to go ahead and put up the left side just the same as he had that side. On most engines the forward motion eccentric is on the outside, or next to the driving box, so Nate took the left forward motion eccentric, lined it up next to the driving box on the left side and lined it up with the forward motion on the right side; that is, he put the belly of the eccentric above the axle. When I saw what he was doing, I tried to explain to him that he was doing it wrong and showed him where to put the forward motion so that the engine would work right when she went out of the shop. But Wright told me to shut up, that I was only a "cub," was not supposed to know anything about it, and was there to do as I was told to do.

We went ahead and put the link, rods and eccentrics up, and as they had moved the engine while we were working under her, the foreman did not get down in the pit to look at our work on the left side, but looking down from the floor and seeing the rods and link properly hung, he took Nate's word for the rest.

In a few days we had the engine ready to run out to give her a trial trip. We pinched her out of the shop, fired her up, and coupled the tank onto her. When we had steam up, the general foreman got on her and started for the transfer table. She moved off as fine as silk, but when the drivers had made about three-fourths of a turn she stopped and refused to go any farther. As this was one of the largest and finest engines then owned by the company, the master mechanic, the traveling engineer and the superintendent of the division where she was to run were all there to see her come out of the shop. When she stopped, the foreman gave her more steam. She then moved a few inches farther back and when she had made one exhaust, she started forward with the reverse lever still hooked back.

After going ahead half a turn of the drivers she stopped, and would not move either way. The traveling engineer got on the engine and when he put the reverse lever down in front, she ran a third of a turn of the drivers and stopped again.

They then put the lever in the back motion again, and when they gave her steam she moved back again to where she had stopped the first time and stopped again. When they gave her enough steam she would move back a few inches and then she started forward again as soon as she had made an exhaust. After working with her for some little time and looking her all over, they pinched her onto the transfer table, and put her back in the shop on another pit. By the time we had got her back into the shop, all the other men were watching the performance and wondering what was the matter.

After the "brass collars" had left the shop, I managed to get my gang foreman by himself and asked him what he thought was the matter with the engine. He said he would be damned if he knew, but was going to find out if he had to take her all apart again to do it. I surprised him when I told him that I could tell him what was wrong. I took him down into the pit and showed him how Nate Wright had put up the left side motion, and told him that I had tried to show Nate where he was wrong. After I told him about it, he got the location of the left main pin and found out that I was giving it to him straight.

After he had carefully examined both sides and saw just what Wright had done he called Wright down into the pit, and if a man ever got a roasting, that man was named Wright. After he got through with Nate, he took me around behind the tank and gave me a fatherly talk about getting him into a bad mess by not telling him how Nate was setting the eccentrics. After he had relieved his mind he sent me back to help Wright to take down the left side and put it up again. I made up my mind that as long as I worked with a threshing machine machinist I would report him if he even broke the point off of a cold chisel.

I would like some of my fellow readers of the *Railway Master Mechanic* to tell what was the matter with the valve motion on this engine, how it was out of place and what we had to do to put it in proper shape.

Richard F. Spamer has been appointed general manager of the Stentor Electric Manufacturing Company, Inc., New York, a recently-formed company which is now taking over the business of the Electrical Experiment Company of the same city. Mr. Spamer was born in St. Louis on March 29, 1878.

Walschaert Valve Gear Design and Adjustment

By Lewis D. Freeman

The use of the Walschaert valve motion has steadily increased since its introduction in this country on heavy power about 1903, until at the present time nearly all new power is so equipped and many old engines are given a Walschaert gear in undergoing heavy repairs.

Much has been written to show the advantages of this type of gear, dealing mostly with the construction from a repair standpoint.

The designer, however, has had to rely upon his own knowledge in designing new gears or correcting defects in existing gears. It is the intention of this article to deal chiefly with the design of the gear to give the best possible results in way of steam distribution, having proven the principles involved by actual tests of locomotives so designed. The information herein has been collected from various sources covering a number of years' experimenting.

GENERAL ARRANGEMENT OF PARTS.

The general arrangement of parts for both inside and outside admission is shown in the following examples:

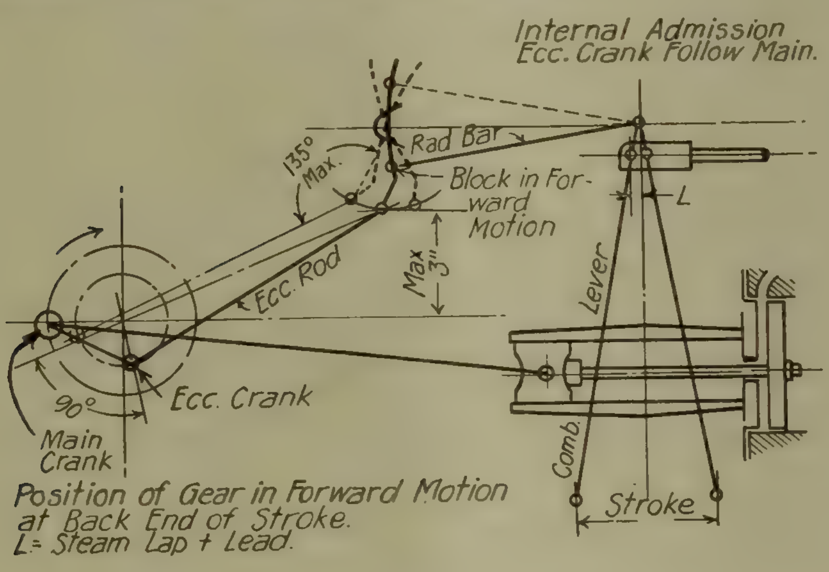


Fig. 1.

Fig. 1 shows the connections for internal admission valves in which the eccentric crank follows the main crank pin and the radius bar connection to the combination lever is above the valve stem, this being a direct motion gear; that is the eccentric rod and the valve move in the same direction in forward motion and the radius bar is below the center of the link.

Fig. 2 shows the connections for external admission valves, in which the eccentric crank leads the main crank pin and the radius bar connection to combination lever is below the valve stem. This also is a direct motion gear, the eccentric rod and the valve move in the same direction, and in forward motion the radius bar is below the center of the link.

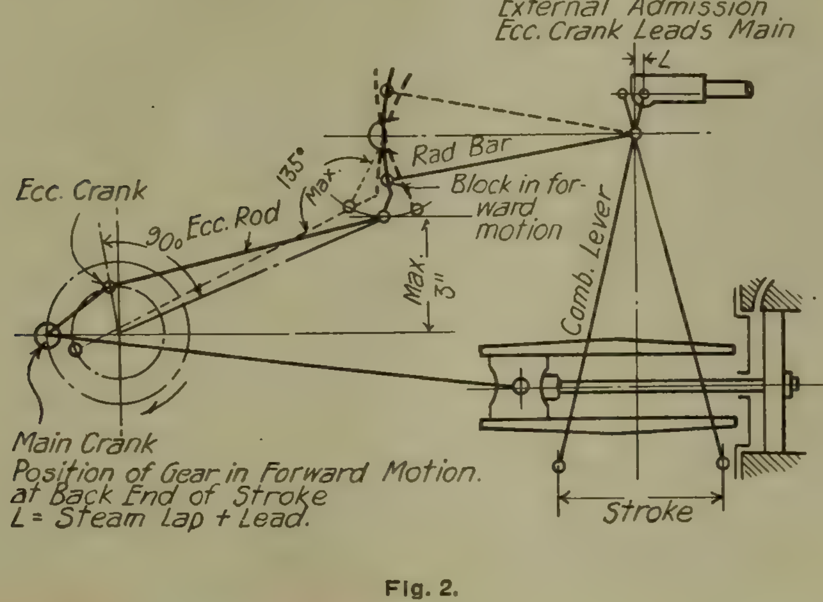


Fig. 2.

The proportion of parts should be such that all pin connections are bushed with steel bushings and supplied with case hardened steel pins. Almost all parts of the gear are subject to clearance limits imposed by the design of locomotive and of course must be worked out for each individual case. Since the motion imparted to the valve stem comes from both the crosshead and main crank pin, it is evident that the combination of these two distinct motions must bear some fixed relation to each other in order to produce as near a kinematic motion as possible in converting the rotary motion of main crank pin into reciprocating motion of the valve stem.

PROPORTION OF PARTS—INTERNAL ADMISSION.

Relative Movement.

Fig. 3 shows a diagram of the proportion of parts for internal admission. The lap and lead movement is transmitted to the valve stem by the crosshead through the combination lever which is fulcrumed at the point F where connected to the radius bar. The stroke of the crosshead and the desired lap and lead being known, the combination lever may be proportioned by the formula R:C::L:V

or

$$V = \frac{C \times L}{R}$$

in which R = Radius of main crank (½ stroke),

C = Steam lap and lead plus $\frac{1}{32}$",

L = Length overall of combination lever,

V = Length of short arm combination lever.

It will be noted that $\frac{1}{32}$" was added to lap and lead movement desired each side of center, or a total of $\frac{1}{16}$" excess travel, in order to take care of lost motion without reducing lead.

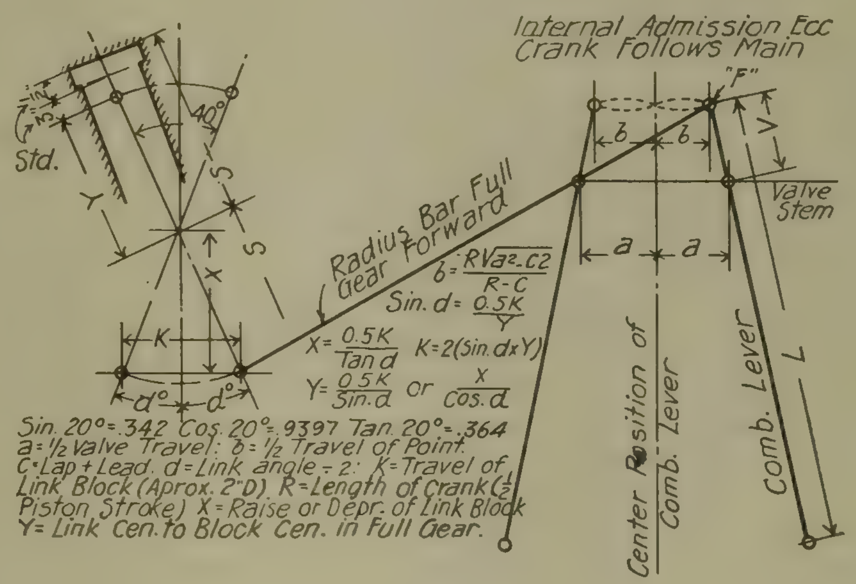


Fig. 3.

The maximum valve travel having been determined by means of a valve diagram, it follows that the movement of the link will be assisted by the lap and lead movement in producing this maximum travel. The radius bar connected to the combination lever at the point F to produce the proper valve travel imparts a certain movement, one-half of which will be indicated by "b," which point describes a double ellipse during a full movement of the valve. The importance of determining the proper travel for this point F cannot be impressed too strongly

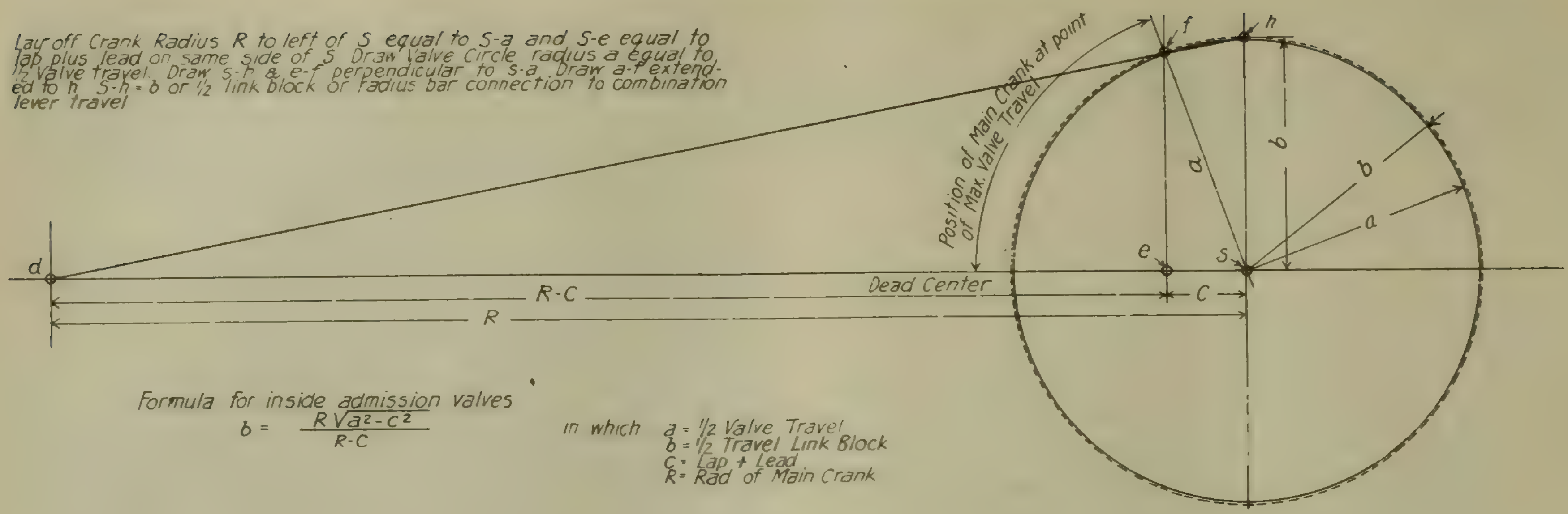


Fig. 4.

since the whole gear is dependent upon this feature. The relation of lap and lead movement to crank movement for a given valve travel can only be determined by the following formulæ:

For internal admission—

$$b = \frac{R\sqrt{a^2 - C^2}}{R - C}$$

in which, $b = \frac{1}{2}$ travel of point F,
$a = \frac{1}{2}$ valve travel,
$C =$ lap plus lead,
$R =$ radius of main crank ($\frac{1}{2}$ stroke).

Proof of this formula is the graphic method shown in Fig. 4. In the case of internal admission valves the lap and lead movement works against the travel of the point F and is therefore deducted from the length of the crank movement. To the left of the point S lay off on a horizontal line the distance R, equal to the radius of the main crank ($\frac{1}{2}$ stroke) and describe the full circle with a radius "a," equal to half the valve travel. Draw the perpendicular Sh extended, lay off the distance C equal to lap and lead at ef to left of Sh. Draw the diagonal sf and from "d" draw df extended to "h." Then sh equals "b," the required radius for point F.

Since ef:R::sh:RC and $ef = \sqrt{a^2 - C^2}$ (also sh = b), we get

$$\sqrt{a^2 - C^2}:R::b:RC \text{ or } b = \frac{R\sqrt{a^2 - C^2}}{RC}$$

It will be noted that the point "f" in Fig. 4 is the point of maximum valve travel, and therefore represents the position of the main crank pin from the horizontal, which for convenience is called the "dead center."

Link Proportions.

Again referring to Fig. 3 the swing of the link should be exactly 40° and in no case over 45°. Practice has demonstrated that a good dimension for one-half of the link slot S is 12½" for internal admission valves. This allows ½" clearance and about 3" from center of link block in maximum position to end of link block fit in link. The travel K of the link block is approximately the same as 2b or the same as the travel of the point F of the combination lever and is expressed by the following formulæ:

$$\text{sine } d = \frac{0.5\,K}{Y} \qquad \text{and } K = 2(\text{sin. } d \times Y)$$

$$X = \frac{0.5\,K}{\text{tan. } d} \qquad Y = \frac{0.5\,K}{\text{sin. } d} \text{ or } \frac{X}{\text{cos. } d}$$

in which $X =$ Raise or depression of link,
$Y =$ Link center to block center in full gear,
$d = \frac{1}{2}$ link angle (should be 20°).

PROPORTION OF PARTS—EXTERNAL ADMISSION.

Relative Movement.

Fig. 5 shows diagram of proportion of parts for external admission. The lap and lead movement is transmitted to the valve stem by the crosshead through the combination lever which is fulcrumed at the point F where connected to the radius bar below the valve stem. The stroke of the crosshead and the desired lap and lead being known, the combination lever may be proportioned by the formula R:C::L:V
or

$$V = \frac{C \times L}{R}$$

in which $R =$ Radius of main crank ($\frac{1}{2}$ stroke).
$C =$ Steam lap and lead plus $\frac{1}{32}$".
$L =$ Length of long arm combination lever.
$V =$ Length of short arm combination lever.

This allows $\frac{1}{32}$" each side or $\frac{1}{16}$" total excess lap and lead movement to take care of lost motion without reducing lead.

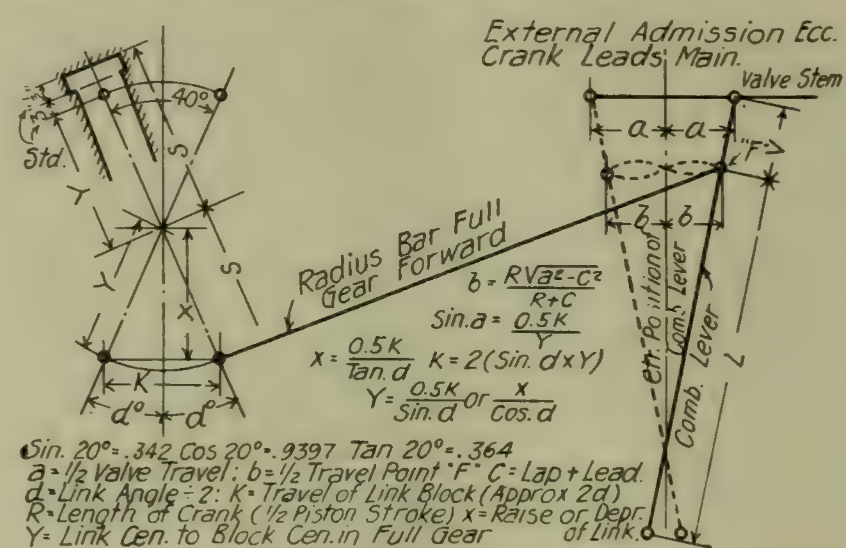


Fig. 5.

The lap and lead bears a certain relation to the maximum valve travel as with internal admission valves. The maximum travel being determined, it follows that the proper travel of point F must be determined in a manner similar to the above formula for internal admission valves. The formula is as follows:

$$b = \frac{R\sqrt{a^2 - C^2}}{R + C}$$

in which $b = \frac{1}{2}$ travel of point F.
$a = \frac{1}{2}$ valve travel.
$C =$ lap plus lead.
$R =$ radius of main crank ($\frac{1}{2}$ stroke).

This formula is proven by the graphic method shown in Fig. 6. In case of external admission valves the lap and lead movement

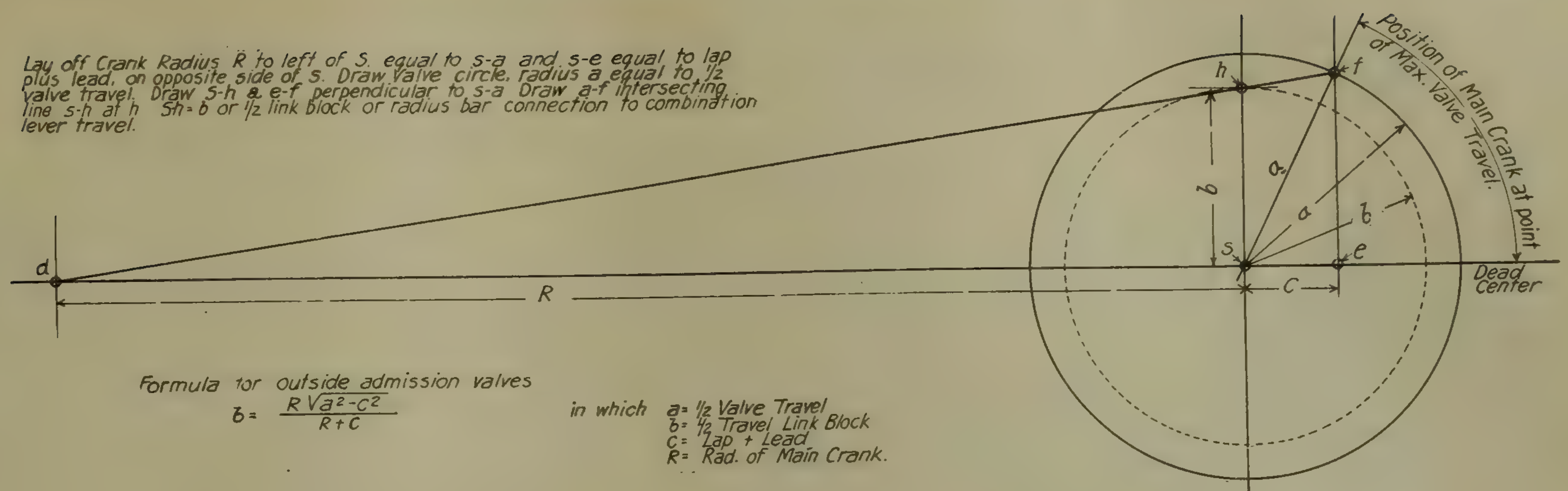


Fig. 6.

works with the travel of point F. It therefore reduces the travel necessary from the link.

From the point S lay off to the left on a straight line the distance R equal to radius of main crank (½ stroke). Describe the circle with a radius "a" equal to half the valve travel and draw the perpendicular Sh extended. Lay off ef a distance C equal to lap and lead to right of Sh. Draw the diagonal sf and from "d" draw df and sh equals "b" the required radius. Since $ef:R::sh:R + C$, $ef = \sqrt{a^2 - C^2}$ and $sh = b$, therefore $\sqrt{a^2 - C^2}:R::b:R + C$, or

$$b = \frac{R\sqrt{a^2 - C^2}}{R + C}$$

The point "f" in Fig. 6 located on the valve travel circle is the point of maximum valve travel as shown on the Zeuner diagram.

Link Proportions.

Again referring to Fig. 5 the swing of the link should be exactly 40° and in no case over 45°. Practice has demonstrated that a good dimension for one-half of the link slot is 11" for external admission valves. This allows ½" clearance and about 3" from center of link block in maximum position from center, to end of block fit in link.

The travel K of the link block is approximately 2b, or the travel of the point F, and is dealt with the same as explained above for internal admission valves, except to substitute the formulæ for external admission valves as given in Fig. 5.

In order to demonstrate the above principles and show manner of application, Fig. 7 represents a valve gear layout for a Pacific locomotive having 24" x 28" cylinders, 74" drivers, hand operated reverse gear and back end of radius bar supported by means of a hanger from the reverse shaft arms. The piston valves have internal admission with 6" travel, 1$\frac{1}{16}$" steam lap, ¼" lead and $\frac{3}{16}$" exhaust clearance.

LAYING OUT WALSCHAERT VALVE GEARS.

Lay out all basic center lines, such as centers of cylinders, drivers and any limiting points, as boiler, frames, cylinder heads, guides and guide yokes, etc., to a scale of 3" or 4" equals 12".

The best paper should be used to minimize the error due to shrinkage of paper. With a thorough understanding of the action of the valves and motion of the gear, it is possible to lay out and prove completely in from 4 to 5 hours, if the instructions here given are followed.

Having laid out the center lines, draw the crank circle equal to the stroke, and with a radius equal to the length of the main rod, cut the crosshead path at A and B, locating the front and back positions of the crosshead. Then strike the arcs DD from A and B with radius equal to length of main rod to prove the crosshead travel.

Draw lines AO and BO, locating the point C exactly half way between G and H. Draw CO extended to C_1, this being front and back dead centers. Then draw C_2OC_3 at right angles to COC_1, these points being top and bottom quarters.

Locate Q_1 at a convenient point on valve stem. Draw the vertical FQ_1R_1, representing the central position of the combination lever, which must swing equidistant each side the vertical to produce equal lap and lead at both ends of stroke. The proportions of the lever are found by the formulæ given above.

Location of the link: It is desirable to locate the center of the link trunnion in the same horizontal line as the point of connection F to the combiantion lever; also to have the radius E of link horn, tangent to center line of drivers. This condition is seldom possible, especially in case of piston valves with inside admission, in which case the radius bar connects to combination lever above the valve stem. It is also necessary to keep the radius E down to reasonable limits, so that the total throw of the eccentric crank will not exceed 20" and preferably not more than 18".

In order to accomplish this, it is necessary to make some concessions. The point Q or link center may be placed below the point F until the maximum inclination of the line FQ is 1" in 12", without any serious effect on the gear as a whole. The link, however, must set square with line FQ, whatever this inclination may be. The radius E of the link horn may be located 3" above the center line of drivers without any serious error.

Describe the central link arc X_1QX from point F with a radius K equal to FQ, cutting radius E at X. Draw the straight line QX which is to be used for locating the points S and T exactly 20° each side of the straight line QX. With a radius equal to XS from X draw the arc ST, proving the points S and T. With a radius K from Q draw ZFY and from S with a radius K cut arc ZFY at Y, and from T cut arc at Z. Then from Y draw SQS_1 and from Z draw TQT_1 locating the desired swing of the link.

Next determine the travel of the point F from the formula given above and lay off half the travel each side of the point F on the valve stem, as at F_1 and F_2. Further divide FF_1 and FF_2 in half as at F_3 and F_4.

With a radius K equal to FQ, from F_1 draw the arc T_2T_3, from F_2 draw S_3S_4, from F_3 draw T_4T_5 and from F_4 draw S_5S_6. This locates the position of the link block on link arc for full and half gear positions; forward motion below the link center and backward motion above the link center. The point of suspension of the radius bar is the distance L back of the link center equal to QV.

Since in a properly set motion the equalization of cut off is also dependent upon the location of the reverse shaft, it is better practice to locate the reverse shaft to give the best steam distribution at the running cut off, rather than in full gear as practiced by some locomotive builders. The center of

the reverse shaft for link suspension of radius bar should be toward the center of the link so the arc of the lifting arms on the reverse shaft will travel in a direction similar to the link arc.

Draw the lines $F_1T_3V_3$, $F_2S_4V_5$ representing the front and back positions of suspension point V of the radius bar, for both full and half gear positions in forward and backward motion as shown, in order to keep the link block slip down to a minimum and consequently the disturbing effect on the steam distribution. There can be but one location for the reverse shaft for each position of the link block in the link as will be described later.

Having located the suspension points V, V_1, V_2, V_3, etc., select a convenient length for the radius bar hanger link. Beginning with points V_8 and V_9, the ideal location for the lifting arm of the reverse shaft is found by striking arcs with a radius M the length of the hanger selected, from V_8 and V_9, locating the suspension point Z_5 for full backward position, from V_6 and V_7 the point Z_4 for half backward motion, from V_1 and V_2 the point Z_2, and from V_3 and V_4 and V_5 the point Z_1.

The points Z_1, Z_2, Z_4 and Z_5 represent the ideal location of the path of the suspension end of the reverse shaft arms from which is suspended the radius bar hangers.

In order to obtain one length of reverse shaft arms to pass through these four points above mentioned it would require about twice the length of radius bar, or throwing the center of the reverse shaft ahead of the cylinders. This arrangement would not be possible and it is necessary to compromise the length of the reverse shaft arms to a length not to exceed the length of the link slot if boiler clearances will permit.

Select the points Z_2 and Z_4 being the ideal location of suspension points for half forward and half backward gears respectively. Then with the radius N from Z_2 and Z_4 strike the arcs intersecting at X_2 which is the location for reverse shaft to give the best possible condition at half gear in both motions. By taking the points Z_1 and Z_5, striking the arcs with the same radius N, the point X_3 is located, being the best location for reverse shaft at full gear in both motions.

From the point X_2 strike the path of the reverse shaft arms with the radius N passing through the points Z_2 and Z_4. The difference from Z_5 to Z_6 and from Z_1 to Z_7 represent the error caused by using the short reverse shaft arms.

ELIMINATION OF ERROR IN REVERSING SHAFT LOCATION.

To eliminate the error of reverse shaft location due to link block slip caused by the short reverse shaft arm, and varying ratio between the constant length M of the reverse shaft hanger and the variable distance from link center to the center of link block in its different positions, some roads have adopted the sliding block suspension for back end of radius bar. In this

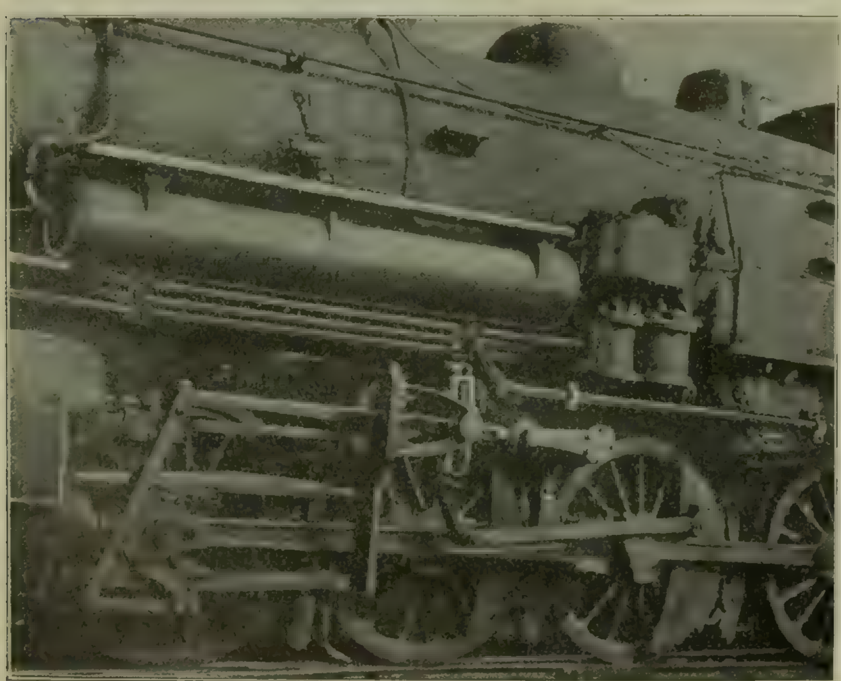


Fig. 8.

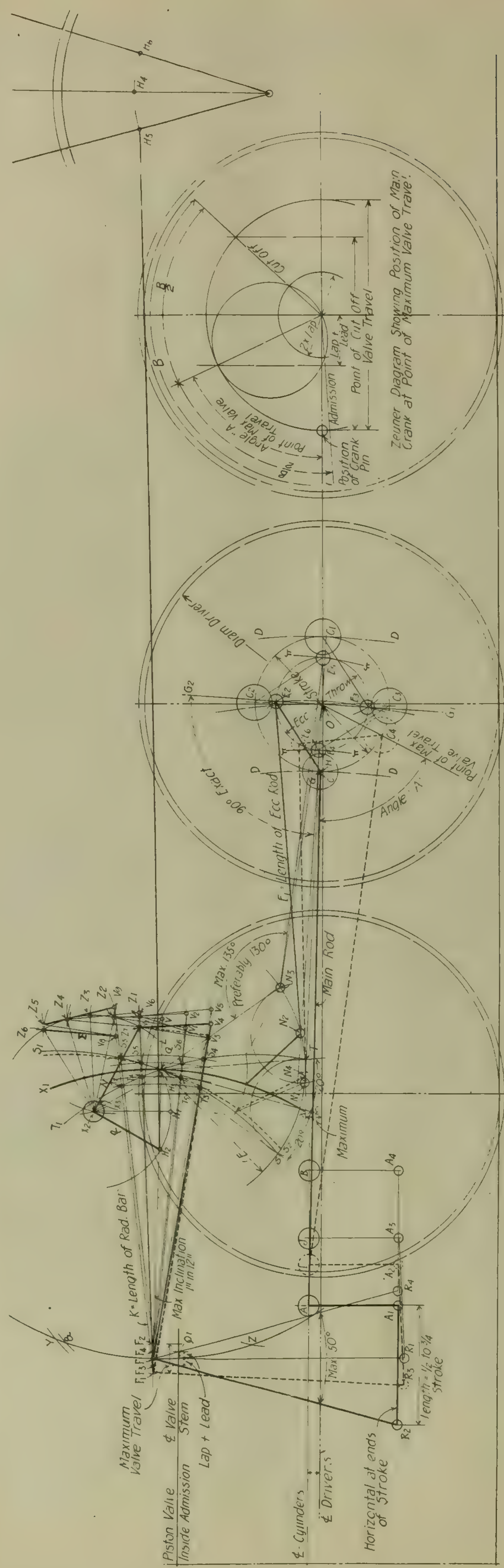


Fig. 7.—Walschaert Gear Design.

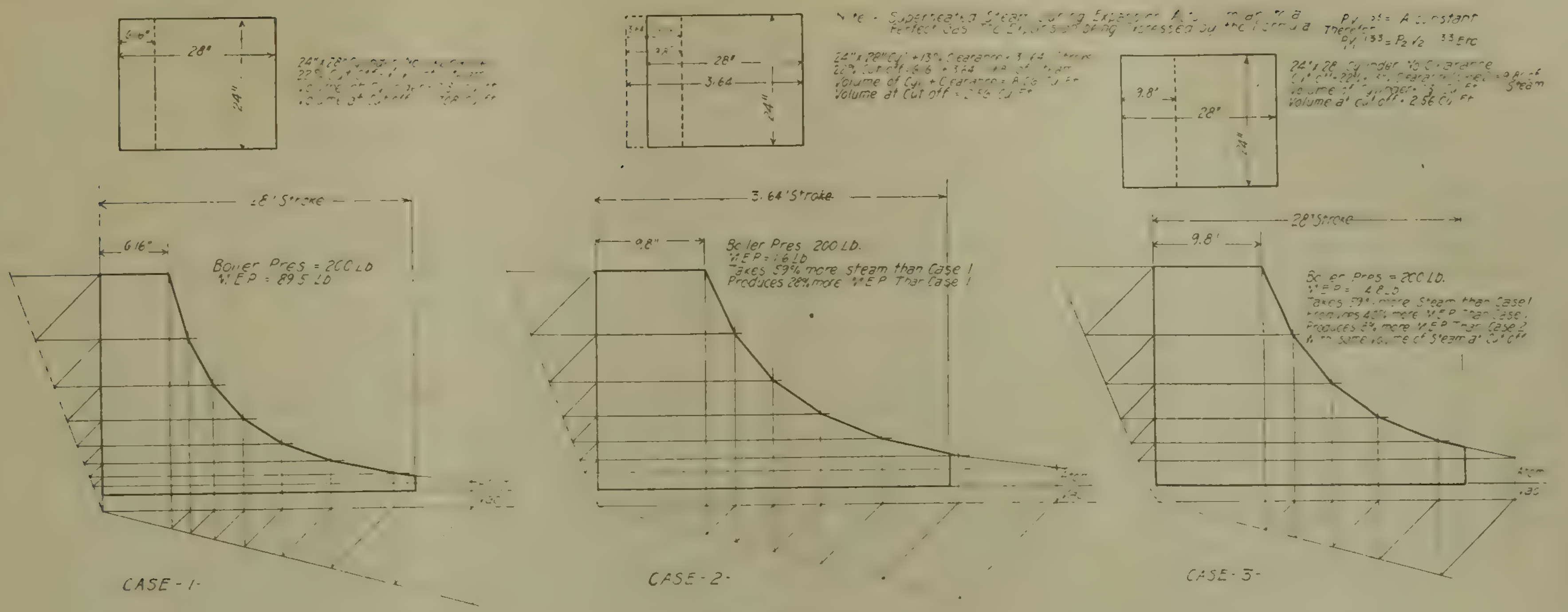


Fig. 12.

case the hanger is omitted and the reverse shaft placed back of the link on the line FQ extended, having a forked end in which is trunnioned a block free to revolve on its horizontal axis. This block has a square hole in center, with means for adjusting same for wear, to fit the square end of the radius bar which is free to slide in the block trunnioned in reverse shaft arms, as shown in Fig. 8.

While some persons claim this is considerably more expensive to maintain, it gives so much better steam distribution that some addition expense is justified. The link block slip is reduced to the difference between a straight line and the height of the arc struck by the link block travel.

ECCENTRIC CRANK POSITION AND THROW.

The location of eccentric crank and proper throw are of equal importance to location of reverse shaft. Again referring to Fig. 7, having determined link arc positions SXT on arc E, select a point N_3 on arc E, draw QN_3 and N_3O to equal 130° and in no case to exceed 135°, draw G_1G_2 through O exactly 90° from N_2O. Next determine eccentric throw as follows: Having located the point N_3, with a radius XS locate N_2 and N_1 on arc E. proving by striking arc from N_2 through N_1 and N_3. With a length E_1 equal to eccentric rod from N_3 and N_1 scribe arcs π-π making eccentric crank circle tangent to both arcs. Proof: from N_2 with a radius E_1 cut eccentric circle which should intersect line G_1G_2 on eccentric throw circle at E_2 and E_3, from E_2 and E_3 with same radius, arcs intersect at N_2 on arc E.

By inspection it is seen that when crank pin is on front or back dead centers the eccentric crank must be at E_2 or E_3, placing the link on its central position and having no effect on the valve travel at this point, while at the same time the combination lever is in full control of the valve and is in full forward or backward position.

When the main crank pin is on top or bottom quarters, C_2 or C_3, the link is at front or back position N_1 or N_3 and combination lever is near the vertical position, since the angularity of the main rod prevents crosshead from assuming the position J shown as half stroke, at which time the link is in full control of the valve and the combination lever has no effect on the valve travel. For this reason the union link between crosshead and combination lever should be horizontal at the end of its stroke, when combination lever has control of the valve opening. This is necessary to produce a true reduction of the crosshead travel to the valve stem.

REVERSE LEVER AND CONNECTIONS.

From the reverse shaft center X_2 with a radius R show the path of the reach rod arm. When radius bar is on exact center drop perpendicular X_2H_1 and with reverse lever on vertical center H_1H_4 is length of reach rod which should be adjusted to meet this condition when engine is hot. Points H_2 and H_3 should be swung equidistant each side of H_1 giving the corresponding points H_5 and H_6 for location of reverse lever in maximum positions. Reverse levers should be so located in the cab that they may obtain maximum positions and clear all obstructions such as piping, etc., by about 6″ especially if power reverse gears are used.

PROOF OR MAXIMUM VALVE TRAVEL.

Maximum valve travel occurs at a point midway between admission and cut off as determined by the Zeuner or other valve diagram, and as shown on back driver in Fig. 7. Locating the position of the main crank as at angle "a" on valve layout and constructing valve gear for this position, it is found that combination lever passes through maximum valve travel on valve stem as shown in dotted lines. By following the above instructions the entire gear may be laid out and proven without the use of a model, as has been demonstrated by actual setting and indicating locomotives having their valve gears designed along these lines. The above design includes some minor refinements that will correct errors detected in such tests.

CLEARANCE VOLUME.

The clearance volume should be kept down to a minimum since the stream in the clearance space does no work until after the valve closes and after the period of expansion, exhausts to the atmosphere, as there is little compression available with a one-piece valve at moderate speeds. The compression is usually about one-fourth of the initial pressure available. In the Pacific type locomotive referred to, there is 13% clearance, making the loss considerable when operating at short cut off and high speed. The effect of cylinder clearance is plainly shown by the three cases shown in Fig. 12.

OBJECT OF VALVE SETTING.

While some persons have stated that if Walschaert gear parts are constructed to standard gauges that valve setting will be unnecessary, this is true in theory only, since the ordinary tools and labor employed in locomotive building it is not possible to manufacture and assemble on a locomotive a complete valve gear without setting the same unless any kind of steam distribution will be accepted. The object of valve setting is to produce an equal pressure on each side of the piston compensating for the displacement of the piston rod, the mean effective pressure on crank end being higher than of the head end to account for the area of the piston rod.

CUT OFF.

The average running cut off for different classes of service is as follows:

Passenger service 25%
Freight service 33%
Switching service 50%

Valves should be set and reverse levers so notched as to permit obtaining these cut offs. The minimum cut off should be 20% of stroke and quadrants should be notched so that it is not possible to obtain less than this cut off. A shorter cut off produces a wide variation in pressure on the piston throughout the stroke, and in turn causing vibration to the machinery that is of doubtful economy.

VALVE SETTING.

Obtain front and back dead centers in the usual manner, also ½ stroke of the crosshead (not quarter position) as shown in Fig. 7. Place reverse lever on center and adjust reach rod until link blocks are on center of links, which can be proven by swinging the links by hand (with eccentric rods disconnected). When no movement is transmitted to valve stem, link blocks are central. Check both sides of engine and change hangers M on reverse shaft arms N until both sides are on center.

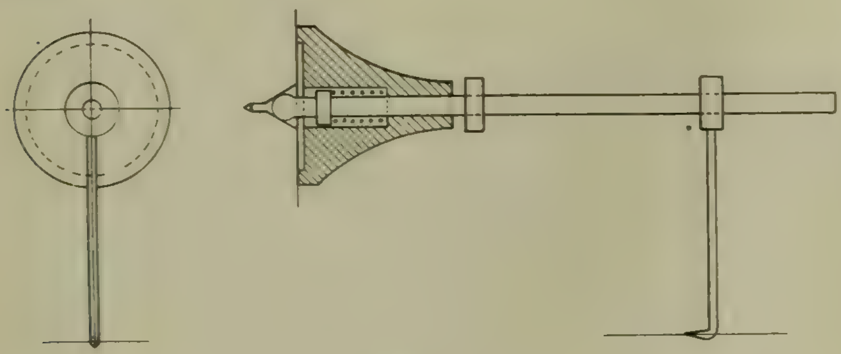


Fig. 11.

Place crosshead on center of stroke, drop plumb line from F through Q1 and R1. Also take lead on both ends, with crank on dead center. Adjust length of union link to produce equal leads at both ends of stroke.

Hook up eccentric rods (length equal to that shown on drawing) to check location of eccentric crank. Place engine on front dead center, with valve tram scratch link horn, place engine on back dead center and scratch link horn. Both lines must coincide; if not shift the eccentric crank until this occurs. Right in this connection it might be well to state that in the event of having to shift the eccentric crank toward the axle to intersect line G1 G2 (Fig. 7) it is necessary to lengthen the crank until same crosses the 90° line referred to, at the proper

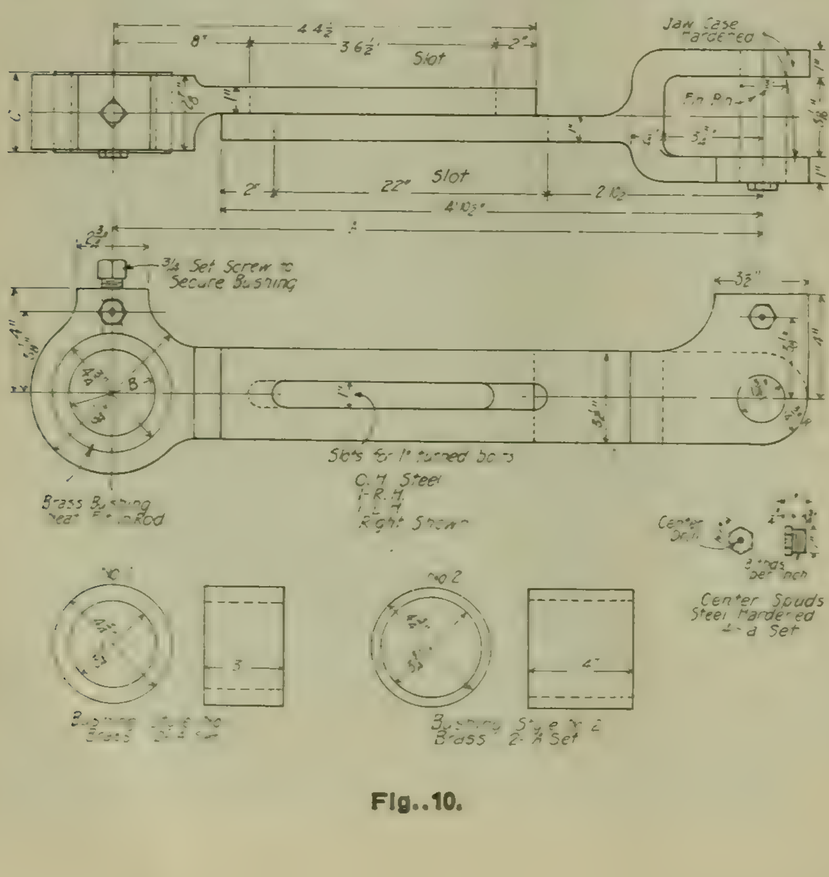


Fig. 10.

distance from the center of the axle. The only reason for having to change the location of the eccentric crank is the possible variation in the distance from the center of the axle to the top of the frame, which distance should be maintained at all times when in service, and especially at time of valve setting. A convenient form of gauge for setting eccentric cranks is shown in Fig. 11.

After locating the eccentric crank, the cut off should be equalized by adjusting the length of the eccentric rods. A pair of adjustable eccentric rods as shown in Fig. 10 is very convenient for this purpose. For example, assume a cut off of 25% for a 24"x28" stroke, having 4¼" piston rod. Place crosshead 7" back of front dead center, moving reverse lever ahead until valve tram cuts port mark. With reverse lever in same position take cut off in back end of cylinder and equalize the cut off for running cut off according to the following formula, for each class of engine.

Find the volume of steam in the front end of cylinder and divide by the area of crank end of cylinder, less area of piston rod, which equals length of cut off at back end of cylinder. To obtain equal volume, subtract cut off in front from back end and multiply the difference by 2 to allow for leakage past packing and keying up rods which usually moves piston ahead. Expressed as a formula:

$$D=2\left[\frac{A \times S}{(A - A_1)} - S\right]$$

In which, A = Area of cylinder,
A^1 = Area of piston rod,
S = Point of cut off head end,
S^1 = Point of cut off crank end,
D = Difference in cut off favorable to back end.

For example:
24"x28" cylinder, 25% cut off equals 7"
cylinder area equals 452 sq. in.
4¼" piston rod equals 14 sq. in.

$$D=2\left[\frac{452 \times 7}{(452 - 14)} - 7\right] = \tfrac{7}{16}\text{" difference favorable to back end.}$$

INDICATOR TESTS.

Indicator tests show cards similar to those reproduced in Figs. 9a, 9b and 9c. Fig. 9a shows a difference of only 46 pounds in total piston load between head and back ends, at a cut off of 21% or very near the predetermined running cut off. M. E. P. was 29 pounds crank end and 28 pounds head end.

Hooking the reverse lever down to 35% cut off, the difference is 1,036 pounds heavy on head end and M. E. P. is equal at both ends of cylinder as in Fig. 9b.

At 50% cut off (Fig. 9c) the condition is still worse, showing a difference of 2,447 pounds heavy on head end, while M. E. P. is 81 pounds on head end and 78 pounds on crank end. This shows conclusively that as the reverse lever is hooked down toward the corner that the balance of the piston load goes to the head end, due to the disturbing effect of the inability to get any one length of reverse shaft arm to suspend radius bar hanger from proper point for all cut offs. This is a further argument for the adoption of the sliding block for radius bar support.

RECOMMENDATIONS.

From the writer's experience it would appear advisable to apply the sliding block for all classes of power. With fast passenger engines the radius bar could be placed in the top of the link, making an indirect motion, in forward gear. This would have the advantage of reduced energy required to reverse the valve at the end of each stroke, since the weight of the radius bar would act against the eccentric rod instead of the rods all working in the same direction. The latter is necessary in case of using the swinging link, in order to get the best distribution in forward gear.

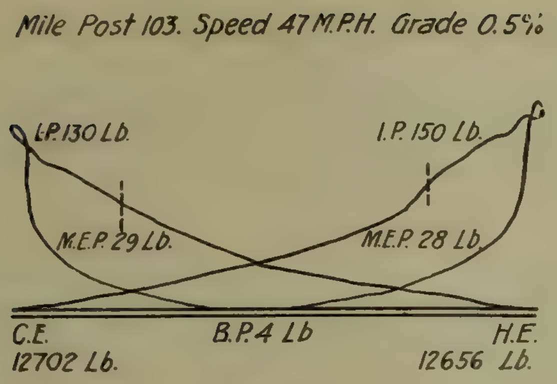


Fig. 9-a.

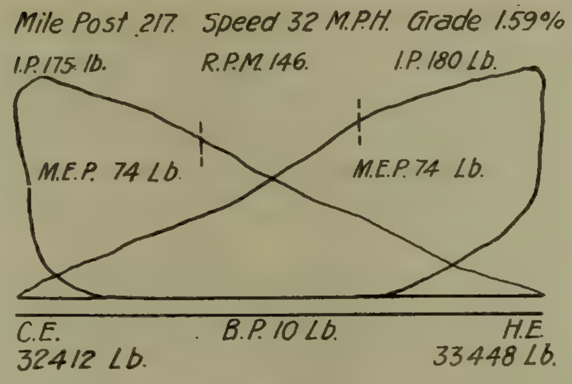


Fig. 9-b.

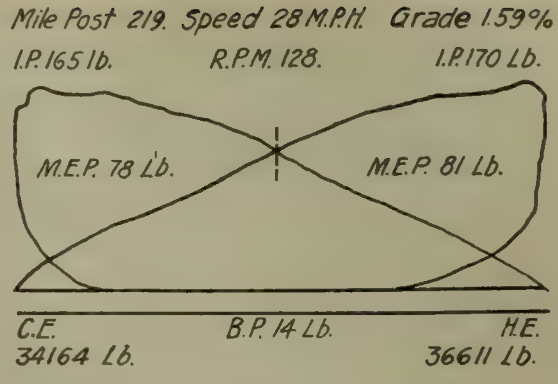


Fig. 9-c.

The present tendency to use the guide yoke for a link support is undesirable. Since the location of the link is not fixed, the strain of reversal of the valve gear coming on the guide yoke alone causes serious vibration, effecting the steam distribution, and counteracting the effects of careful setting.

The link should be supported on heavy plates and firmly braced to the cylinders in order to take the thrust and not transmit same to the guide yoke.

LIFE OF VALVE GEAR.

Experience has shown that passenger locomotives, doing part local work, will make about 75,000 miles, over fair track, before collecting ⅛" lost motion up to the valve stem. This should be the limit for going over the gear and renewing the pins and bushings. Freight locomotives will run about the same for wear, but can be allowed to run until 3/16" lost motion has collected, which will indicate about 100,000 miles service.

MALLET VALVE GEARS.

Mallet locomotives using Walschaert valve gear, are usually equipped with air or steam reverse gears. In setting such valves the back engine should be set first. Put reverse lever on center, adjust reach rods to front engine until all link blocks are on link centers. Remove eccentric rods and swing each link, without moving valve stems. Set front engine, and if properly designed both engines will have the proper cut off to give the proper amount of work.

The writer recently investigated some cases where Mallet locomotives were not pulling their rated tonnage and slipping badly in the back engine. It was found that the back engine did not receive full valve travel due to reverse lever movement being restricted in cab, but front reach rods have been lengthened to give front (L.P.) engine full travel, with the result that the high pressure engine cut off short, while the low pressure engine took steam for the full cut off period. The receiver pressure fell from 68 pounds normal, to 35 pounds, thus relieving the high pressure cylinders of 33 pounds back pressure, overloading the high pressure pistons and causing the slipping referred to.

For general practice, high pressure engines should cut off at 90% of the stroke, while low pressure engines should cut off at about 84% of the stroke to allow for the shrinkage of volume of steam leaving the high pressure cylinders and loosing heat in passing through the receiver.

CONCLUSIONS.

From the above it may be seen that a slight variation in cut off greatly affects the load on the piston, consequently the turning moment as applied to the wheels. This difference should not exceed 1% from one side of the piston to the other, corresponding to top and bottom quarters, in running cut off. Greater differences will tend to produce stalling on heavy grades at slow speed and undue strains on the machine as a whole. The remedy is to take one engine of each class and set valves to get the best results as shown by accurate indicator tests, setting the other engines accordingly.

The Missouri, Kansas & Texas of Texas has completed a new terminal at East Waco, Texas, comprising 21 miles of track, a 30-stall roundhouse, small shops and a water treating plant.

THE CAPACITY OF SUPERHEATER LOCOMOTIVES.

It is now fairly accepted that superheater locomotives are more economical than those using saturated steam, not merely as regards fuel costs, but also over-all at the end of the year's working. Anyone in touch with practical opinion on this matter can hardly fail to come to such a conclusion. The student of locomotive problems is also not surprised that improvement for the superheater locomotive is claimed as regards capacity. It would prove tedious were we to endeavor to quote the many statements made showing this expectation to be realized. The fact has been publicly attested on innumerable occasions, and is, as far as our experience goes, the uniform opinion of those in direct charge of the running and working of such engines.

It is well known that the capacity of a locomotive, within limits, may be increased by forcing up the rate of firing, though at some loss in boiler efficiency. In fact, at anything beyond moderate speeds, usually about 15 miles per hour, the capacity of an engine is dependent upon and limited by the ability of the boiler to supply the cylinders with steam. This, of course, postulates satisfactory design of cylinders, steam-passages, etc., so that there shall not be uneconomical wire-drawing, choking of the exhaust, and so on. This limitation is at the back of the modern tendency to supply locomotives with larger boilers than formerly, in comparison to cylinder sizes, within working limits, the enlarged boiler alone permitting of higher rating. Similar reasoning will lead to the conclusion that, given two engines, one more economical than the other when handling equal loads, the former, when both are forced to equal rates of coal consumption, will have a greater hauling capacity than the latter, though perhaps accompanied by some falling off in efficiency. Translated into figures, the argument often takes some such form as, for example, the following: Suppose a locomotive develops 1,000 horsepower when burning 2,500 lbs. of coal per hour, a similar engine, but one more economical by 20 per cent, in the same service would use only 2,000 lbs. per hour, or 2 lbs. per horsepower; if, therefore, it is held, the latter were forced up to a rate of consumption of 2,500 lbs. it should develop 1,250 horsepower. This plausible reasoning fails, unfortunately, by not taking into account the fall in boiler efficiency as the output is forced up.

That such a decrease occurs in the case of the saturated-steam boiler is now accepted. The point was fairly clearly brought out in Mr. Lawford H. Fry's paper before the Institution of Mechanical Engineers in 1908, in which he discussed the Pennsylvania railroad tests at St. Louis. The data thus provided were utilized in a paper read before the Institution last session to show what effect this decreased efficiency had on increased capacity at equal rates of firing. The effect naturally varies with different conditions, but there is evidence tending to show that superheater locomotives are affected in much the same way as non-superheater engines, in spite of the advantage of the higher superheat at the higher outputs. It may be well to call to mind the fact that, in the second paper referred to, a case was noticed in which an increase of power of 33⅓ per cent had been anticipated, whereas if account had been taken of the falling off in boiler efficiency an increase of perhaps 20 per cent only would have been expected, the latter figure prov-

ing to be, as a matter of fact, comparatively close to the actual increase in power realized.

The difficulty of making just comparisons on the question of maximum power between saturated and superheated-steam locomotives is largely due to the want of some standard for the generator unit. The introduction of a smoke-tube superheater usually adds to the weight of the steam-generator to the extent of from 15 cwt. to 25 cwt. or so. Should this weight be allowed, or should the generators be compared on an equal weight basis, or on some other? In ordinary circumstances the introduction of the smoke-tube superheater reduces, as a rule, the water-heating tube surface, though to what extent is again a matter dependent upon the designer. It commonly happens that this reduction amounts to something in the neighborhood of 20 to 25 per cent of the tube surface. Since about 35 per cent of the steam production takes place in the surroundings of the fire-box, leaving only 65 per cent for all the tube surface, the water-surface steam-producing capacity is only reduced from the 100 per cent in the saturated boiler to about 85.5 per cent in the superheater boiler, a reduction of 14.5 per cent in capacity for about 22 per cent less tube area. Again, since the superheater engine uses less steam than the other by between 20 to 25 per cent, there is at once, evidently, a margin which can be translated into additional capacity without even forcing or working at rates of heat transmission through the water surface higher than in the saturated steam boiler—that is, of course, unless the process of transmitting heat through the superheater counterbalances the advantage gained.

Apart from other reasons, these features of design give the superheater boiler something of an advantage as regards capacity. For this increased capability to be of real value, however, cylinder conditions must be taken into account. Considering the matter strictly from the engine point of view, we are immediately faced by the fact that the expansion line for superheated steam falls below that for saturated steam, and it is usually concluded therefore that the mean effective pressure for the former is less. Some interesting indicator cards bearing on this point and taken at equal cut-offs, etc., are given in the Pennsylvania Railroad Company's report of tests conducted by C. D. Young at the company's testing plant at Altoona, under the direction of J. T. Wallis, general superintendent of motive power. These tests were on 4-4-2 type express engines. The indicator cards show that though the expansion line of the superheater is lower, the exhaust line is also considerably lower, with the result that the mean effective pressures of the cards for the superheater and non-superheater engines are practically identical. As this is the result of work on a testing plant—appliances held in contempt by certain folk—we may further refer to H. Fowler's recent paper before the Institution of Civil Engineers as showing exactly the same effect in trials on the road.

This remarkable confirmation is, to those who will profit thereby, one more proof of the value and accuracy of many of the lessons which testing plants can be made to bring out, and we commend it to those in whose opinions it has been hitherto held that tests thus made give no indication of actual performance. Standing alone the "expansion line" argument does not give the whole truth. Back pressure is an important point, and therefore other factors affect the situation, such as the size and shape of the blast-pipe top. In the Midland engines, compared by Mr. Fowler, the cylinders and blast-pipes were identical. In the Pennsylvania tests the shape of the blast orifice had been changed in the course of the tests from a circular to a rectangular one, so that unfortunately a factor was introduced which, for the sake of clear deduction, should preferably have been absent. Normally it is found advisable, with superheated steam, to reduce somewhat the blast-pipe top, in order to secure a good velocity of discharge with smaller weight of more fluid steam, though, of course, owing to the economy realized, less coal is burnt and less flue-gases have to be entrained. It may, however, prove that, if some other feature of design, not yet fully understood, is properly attended to, such a reduction may not be essential to the production of maximum power. The Midland Railway experience is suggestive on this point.

Taking it, then, that in the cylinder at equal cut-off superheated and saturated steam may give approximately the same mean effective pressure, the actual effect of the increase in generator capacity, is at equal rates of firing, to render it possible to work either at increased speed or with longer cut-off at the same speed, allowing higher rating of the engine. Since for every class of locomotive there is a speed and cut-off at which it is most economical, an increase of cut-off to take advantage of the greater capacity will be accompanied by some falling off in efficiency. This is so with both saturated and superheated steam, though whether in the same degree is not quite clear, since a variable is introduced in the case of the superheater, as the superheat rises with increased cut-off. In that engine these two may possibly counterbalance one another for a time at least. The loss in cylinder efficiency may be avoided by the adoption of larger cylinders, a resource which is perfectly justifiable, and is not, as some would argue, a subterfuge to procure a strong machine with a weak working agent. Engines should always be designed to perform most of their work at an economical cut-off. If there is every possibility then of the superheater engine being loaded up, it would only be consistent with good design to provide the large cylinders, rather than work with an uneconomically long cut-off. If, on the other hand, superheating be adopted purely for the sake of fuel economy, the cylinders need not be increased, as the economical cut-off will then be retained. Indirectly larger cylinders may be adopted, in order to reduce boiler repairs, as they permit, for equal work, of a lower boiler pressure.

Reverting for a moment to the question of blast-pipe tops, it would seem from recent tests at Altoona, and elsewhere in America, that there may yet be a good deal to learn in this direction. The result of tests at Altoona has been to show that a circular top does not give nearly such evenly-distributed pressures in the chimney as do rectangular or elliptical orifices. With the circular top the pressure is high in the center and low at the edges. With the rectangular or elliptical top the pressure at the edges, which come most in contact with the gases the blast has to entrain, is a good deal higher. On other lines trials have been made of tops other than circular, and with reported good results. The reasons for these improvements do not appear clear at once, and it would be interesting if further investigations were conducted into the matter.—*Engineering of London.*

SINCERITY.

Sincerity is one quality without which the business man cannot hope for success nor respect.

It is a quality that is often counterfeited, but the false sincerity soon becomes apparent; it can be sensed more readily than any other assumed attribute.

The possession of sincerity or its acquisition—for, like other qualities, it can be acquired—is largely a matter of environment and association. With some it is inborn; with others it is acquired through earnest effort and unsparing frankness with oneself.

It is well to believe that most men are sincere. Were this not the case, the world would not be the pleasant place it is.

Given sincerity, energy and dependability, but especially sincerity, a man will go far in this life of ours.—*Brill Magazine.*

THE COMMISSION ON INDUSTRIAL RELATIONS has drawn up a tentative draft of a bill creating a national board of mediation and conciliation to deal with all strikes and lockouts in any part of the country that seem likely to involve the federal government. The bill provides strictly for voluntary conciliation, and expressly denies to the board any compulsory powers of arbitration or prohibition of strikes.

The Fundamentals of Apprentice Instruction

By D. C. Buell, Director, Railway Educational Bureau

The time has long since passed when there should be any argument as to the necessity for the instruction of shop apprentices. An article prepared a short time ago by Mr. Basford and presented before the New England Railway Club, sums up the situation so completely that it will stand as a classic on the subject for years. The Master Mechanics' Association years ago recognized the importance of the subject and outlined a method for the systematic handling of apprentices in the shop. A few of the larger railroad companies have organized elaborate and more or less expensive systems of apprentice instruction, but the fact remains, nevertheless, that on the large majority of railroads of this country little or no attention is paid to this most important subject.

It is axiomatic, when all are agreed as to the necessity for apprentice instruction but only a few are systematically carrying out a system to meet this need, that some basic difficulty exists that deserves the most careful attention and study. Why is it that one road will spend $40,000 or $50,000 a year ungrudgingly educating its apprentices whereas another road does nothing along this line? Why is it that the few well directed apprentice systems that are in effect vary considerably in their methods of operation? Why is it that if all are agreed that proper apprentice instruction is a good thing and in fact a necessity, we do not have a fairly uniform system of instruction in effect in practically every one of our railroad shops today? There must be a reason. Can't we analyze conditions and find out what that reason is, so as to pave the way to accomplish better results?

WHY DO WE HAVE TO EDUCATE APPRENTICES?

In a large majority of communities the railroads are the largest single taxpayers. A considerable percentage of the revenue from taxation goes to the support of the public school system. Nevertheless, it seems to be almost universally the case that the public school does not educate the rising generation so as to turn out boys that are of any particular use to the railroads. There are two reasons for this. One is that years of tradition among educators leaves us supplied with schools teaching along academic lines, although almost two decades have passed since our country entered an industrial era. Had the schools kept pace with the times it would have brought about industrial education in the schools for the majority and academic education for the minority instead of the conditions being reversed even at the present time, fifteen or twenty years after the demand for industrial education became apparent.

The fundamental principle of the problem, therefore, seems to be a further awakening of educators to the necessities of industrial education to keep pace with the demands of the time.

On the other hand, the railroads are at fault in not having made shop work an attractive profession, so that a better class of boys would have sought shop apprenticeship as the first step in their life work.

Both of these conditions are receiving attention at the present time. Educators are advocating vocational schools, technical high schools, cooperative educational systems, etc., and mechanical department officials are seeking to make shop work more attractive so as to interest a better class of young men in entering the ranks.

It is herewith submitted that the day should and will come, in the not too distant future, when the railroad will not have to teach its apprentice boys how to read, how to write, how to do simple arithmetic, nor any of the other things that the average eighth grade graduate should be able to do well.

PRESENT CONDITIONS.

Present conditions in practically all shops, except those that have had comprehensive apprentice systems in effect for five or six years, present three or four basic features that can neither be denied nor evaded. The first is that many apprentice boys in our shops today cannot read understandingly. Only yesterday a third-year boilermaker apprentice came to my office. This boy, or man, for he must be at least twenty-one, is a very bright chap, a good talker, understands fairly difficult words when used in conversation, and has a first-class record as a shop apprentice. In his efforts to further better himself he took out a correspondence course in boiler layout work. The difficulty, however, was that he could not read. I sat down with him and tried him out on the proposition. He could only read the simplest words and while he would have understood most of the words in the lesson had they been read to him, they were meaningless when put before him in cold type. This man is married, has a baby, his wife has been through eighth grade, but with the cares of the household and the baby, did not feel that she could give him the necessary help to teach him to read. He is now going to night school to learn reading, so that he can go on later with his instruction.

This is only one example. There are many similar ones. We are up against facts and not theories in this matter, and if we expect our present apprentices to grow up into competent, efficient journeymen, from whom can later be made the necessary mechanical department officials, the changing conditions require that we must count on the necessity of helping such men as this, as well as those apprentices who are better equipped educationally.

There is no use arguing about what the public schools should have done or what the conditions should be. It is a proposition of getting busy and inaugurating an efficient plan of educating and holding apprentices at a cost so reasonable as to preclude the possibility of criticism or of the plan being disturbed during periods of retrenchment.

WHY ARE NOT MORE APPRENTICE SCHOOLS STARTED?

This seems a fair and pertinent question and involves fundamentals again. There are several reasons.

First: Practically all systems of apprentice instruction in effect today are more or less expensive.

Second: They require a special schoolroom. This in turn requires authority for the necessary expenditure; such a room not being available at most points. Considerable equipment is also required.

Third: As generally conducted, a system of instruction that is at all comprehensive involves a considerable increase in payroll.

Fourth: It is not easy to find the right man to handle such a scheme.

Fifth: A certain amount of opposition must be overcome as regards the attitude of the organization; that is, not all master mechanics, foremen, etc., are found to be in sympathy with the idea.

Sixth: The apprentice boy himself balks and makes the plan hard to put into successful operation.

An attempt will be made to demonstrate that of the first three conditions, which are the most important factors in the problem, the first two become relatively unimportant if a new method of instruction is adopted, and that the third item loses much of its importance if the ideas embodied in this article are correct. The fourth item is becoming less important every day, because with the growth of apprentice instruction systems more trained men are available than heretofore. In fact, if a system which has already been worked out successfully is adopted, it is not difficult to find a man who can properly organize the work and get it going successfully. The fifth and sixth items are the least difficult of the lot. The apprentice boy takes to the work like a duck takes to water, as soon as he has gotten into it, and the shop organization is the most enthusiastic supporter of the apprentice school when properly organized and conducted.

WHY SHOULD A LARGE APPROPRIATION BE NECESSARY TO START SUCH WORK.

The cost of apprentice instruction under the present systems in-

cludes the cost of building or furnishing an elaborate schoolroom, the supplying of drawing tables, drawing instruments, tools, etc., the costly preparation of instructional matter, the fairly high salaries of quite an elaborate organization during the organization period, and the considerable increase in the payroll for the necessary apprentice instructors. All these expenses can be attributed mainly to two things. First: To the method adopted of teaching mechanical drawing as the first work of the apprentices. Second: To the lack of necessary instructional matter.

WHY TEACH MECHANICAL DRAWING?

Why teach mechanical drawing to the apprentices as the first work in the school? Why, indeed? Go into the shop and ask any foreman what he wants a boy to know. You would have to go a long way to find a foreman who would say he wanted his apprentices taught mechanical drawing. What he wants the boys to learn is how to read a blueprint correctly, how to make a simple shop sketch, how to do enough arithmetic to work out the ordinary problems met in figuring out dimensions, etc., and in addition, as the boy advances, the principles of the shop practical problems that routine work involves. True enough, teaching the boy mechanical drawing eventually teaches him to intelligently read a blueprint, but why put the cart before the horse? It is much easier, quicker, and more satisfactory to teach the boy how to read working drawings, direct, than to have him spend a couple of years learning to be a draftsman so that he can read a drawing.

After the short time necessary to learn how to read working drawings, the apprentice can then be taught shop sketching. He will have learned, in studying these two subjects, practically all of the principles of mechanical drawing, and the small percentage of the apprentices that show ability along drafting lines can then be taught mechanical drawing in their third or fourth year, if deemed advisable and desirable.

Teach the boy how to read a drawing, how to make a sketch, the simple shop arithmetic that he needs to know to be a proficient workman, and other elementary subjects, such as penmanship, letter-writing, report-making, etc., during the first part of his apprenticeship. Follow these subjects with lessons on shop practice, and you overcome the first great difficulty. You no longer need an elaborate schoolroom, drawing tables, drawing instruments, nor anything that costs money, to start with. A few rough benches and a blackboard in some vacant corner in the office building, storeroom or shop, and a few instruction books that can be purchased in the open market, are all that is required in the way of equipment. In eleven shops on the Illinois Central and Central of Georgia, where apprentice instruction was started on this plan, not one cent had to be spent for schoolrooms or school equipment save for the negligible cost of blackboards and rough benches.

THE INSTRUCTION COST.

The next item of importance is the instruction cost. The usual practice in present apprentice school systems is to hold classes of two hours' duration, two or three times a week, or classes of three hours' duration, twice a week. There is only one reason for this length of session and that is that the boys are taught mechanical drawing in some of these classes, and short sessions are not as practical as longer ones when mechanical drawing is being taught. Aside from this I can see no good reason for the two or three hour session.

Educators the world over seem to favor short class periods. In none of our public schools are the recitation periods of more than thirty or forty-five minutes' duration. The majority of recitation periods in our universities are of forty-five minutes' duration. In some few exceptions one hour recitation periods are used. If educators the world over, dealing with *students,* surrounded by a "study" atmosphere, do not find it practicable to hold classes for longer periods than thirty or forty-five minutes, why should we expect an apprentice boy, who is not a student, who is not by any means surrounded by a "study" atmosphere, to be able to pay attention and retain what is taught during a two or three hour session? It does not look reasonable.

Why not a half-hour session? By starting in at seven o'clock in the morning and working through the forenoon there is time for ten half-hour class periods—enough to handle every apprentice boy in all but the largest shops, in small classes for a half-hour every day, only using a half-day, or less, of an instructor's time. This gives each apprentice three and a half hours a week—nearly as much time as with any of the other plans mentioned. Reading working drawings, shop sketching or shop practice can be taken up one morning; mathematics, letter-writing, report-writing, etc., the alternate mornings.

In actual experience, bright apprentice boys, who knew nothing whatever about drawing or reading drawings, have learned to read simple shop blueprints in forty of these half-hour sessions. The boys come to class knowing that the time is short. They are interested. The time is all too short. They go away wanting more instead of satiated due to a longer period, and they remember what they have been taught. This plan is no more disturbing to the shop routine than any other. The scheme works, and works well; in fact it seems the really logical and practical method.

On the other hand, the advantage in cost of instruction is worth considering. In a shop where there are seventy apprentices, by handling only seven boys in a class, the instructor is through with his work by noon and has the afternoon for special work, doing the drafting for the master mechanic, inspecting safety appliances, or other productive labor. In a large shop where from fifty to seventy-five apprentices are employed it is possible to handle the instruction for a cost of one-half of a \$100.00 or \$110.00 man's time. One instructor working full time can handle the proposition in the largest shop, and in the smaller shops, where there are not over ten apprentices, the tool-room foreman, master mechanic's chief clerk, or any other available man who has the necessary qualifications, can handle the apprentice instruction by holding two half-hour sessions each morning. One hour of his time is sufficient to insure the success of the scheme, and the instruction can be inaugurated practically without expense.

SHOP INSTRUCTION.

The instruction of the apprentice in the shop is, if anything, more important than the classroom instruction, nevertheless it is at this point that many otherwise good apprentice systems go completely wrong.

It should be remembered that the boy in the shop belongs to the shop foreman. He does not belong to the apprentice instructor, and while it is essential that the apprentice instruction system should cooperate and assist in the shop instruction and perhaps plan out the different phases of the boy's work in the shop and keep in touch with the boy at all times, the system should be so devised that the shop organization will be responsible for the boy's work and progress *in the shop,* irrespective of the apprentice instructor.

The experience in the majority of apprentice instruction schemes is that as soon as the scheme wins the confidence of the shop organization, this organization is only too willing to have the supervisor of apprentices and his instructors assist to the fullest practicable extent in the shop instruction work.

In this connection it will be well to note that with the instruction plan outlined there is plenty of time available for the classroom instructor to do a certain amount of shop instructional work; in fact, experience has proven that as soon as the classroom instructor demonstrates his ability and wins the confidence of the master mechanic or shop superintendent he is assigned to such instruction work in the shop at the smaller points—the one man being able to handle both the class and the shop instruction where there are not over twenty-five or thirty apprentices employed.

TEXTBOOKS.

Any amount of shop practice lesson texts have been prepared in connection with the different apprentice systems. With few exceptions, however, these texts are not generally available. However, there is no reason why they should not be. The New York Central System and the Santa Fe System both have most excellent series of lessons. The Educational Bureau of the Harriman Lines developed a very complete set of lesson texts to be used in connection with the apprentice instruction work conducted under its

direction. These latter texts are now available through the medium of the Railway Educational Bureau.

In other words, there is at present available, for merely nominal cost, a sufficiently complete set of lesson texts for apprentice instruction purposes without the necessity of a special organization or excessive first cost in order to provide suitable instructional matter for such work.

In view of the foregoing it can be seen that for a merely nominal cost any railroad can at present inaugurate a safe and sane system of apprentice instruction to quite comprehensively cover its requirements. With the fundamental principles, as outlined above, provided for, each road can elaborate for itself its own system of employing apprentices, weeding out those that prove inefficient, taking care of the "play" side of the boy's life by means of athletic games, apprentice meetings, etc., as may seem desirable. In addition to this, the method of routing the boy through the shop so that he will thoroughly learn his trade and be given experience in all the various branches, can be scheduled and intelligently directed.

CONCLUSION.

Irrespective of the particular method, cost, or any other consideration, apprentice instruction is absolutely necessary, and no matter what the cost, if properly conducted, pays for itself. Its importance is too great to be longer neglected. Its sponser should be the operating head of the railroad, and all concerned should give their heartiest cooperation to insure its success.

The boys must be treated fairly, taken care of, and made to see that the opportunities for promotion and for recompense commensurate with their ability, lie before them as they advance step by step.

TWO KINDS OF EXECUTIVE.

We take this opportunity of pointing out one lesson to be learned from the operations of the master mind which has built the Panama Canal; a lesson for executives and assistants alike.

Colonel Goethals authorized the following statement as to one of the canal commissioners, Colonel Hodges: "Charged with the solution of the most important engineering problems of the canal, it can be truthfully said of him that the canal could not have been built without him," and in a statement as to the value of the services of another of the commissioners, Civil Engineer Rousseau, "he has been as indispensable to me as Colonel Hodges."

All who have been privileged to observe the organization of the force on the isthmus and the work it has done, agree as to the loyalty, zeal, devotion and spirit of assistants and employees. These authorized statements give us an idea of how this esprit—for the lack of a better general term—was fostered.

The really "big" man, the successful executive and administrator, parcels out the work to his assistant, gives them supremacy in their respective fields, and backs them up; when they succeed he publicly gives them the credit for doing the work, literally advertising them, their work, and their capabilities.

Upon analysis of the results of this policy, it must be evident that the greater renown attaches to his name; for it is he who has selected these assistants, judged their worth, trained them, directed their efforts, inspired them and controlled them. When he praises the deserving assistant he, perhaps unconsciously, but none the less effectively, shows evidence of his own sagacity and ability, and he shows his caliber.

It is the small-minded executive who fears to boast of his fine assistants, lest to them should go the credit for their work. His assistants, as a rule—and not unnaturally, we think, nor without justification—are on the lookout for another field; rather than for opportunity to do more where they are; their full capacities are not developed; their spirit is repressed, rather than fostered.

The broad-minded executive develops his good men, works them into positions of increasing responsibility and opportunity, and is in turn carried by them to success unattainable without their assistance. They work for him better than they know how.—*Exchange.*

TEST OF JOURNAL JACKS.

By V. T. Kropidlowski.

Some time ago the writer had occasion to perform some tests on small journal jacks of the geared screw type. The information derived as to the efficiency of the screw and the power necessary to be exerted at the end of the lever is both interesting and useful. The means by which the tests were made are also well worthy of mentioning, for most any ordinary railroad shop has them at hand.

The table contains all the data, but it needs explanation as to how some of the items were arrived at.

To start with, a lever was made of good tool steel to fit the sockets of the jacks. Thirty inches from the center of the pinion or, which is the same thing, the screw of the jack, a notch was made in the lever, as shown in Fig. 1, where the arrow with the word "power" above it points to.

The tests were made, in one instance, in an upright hydraulic

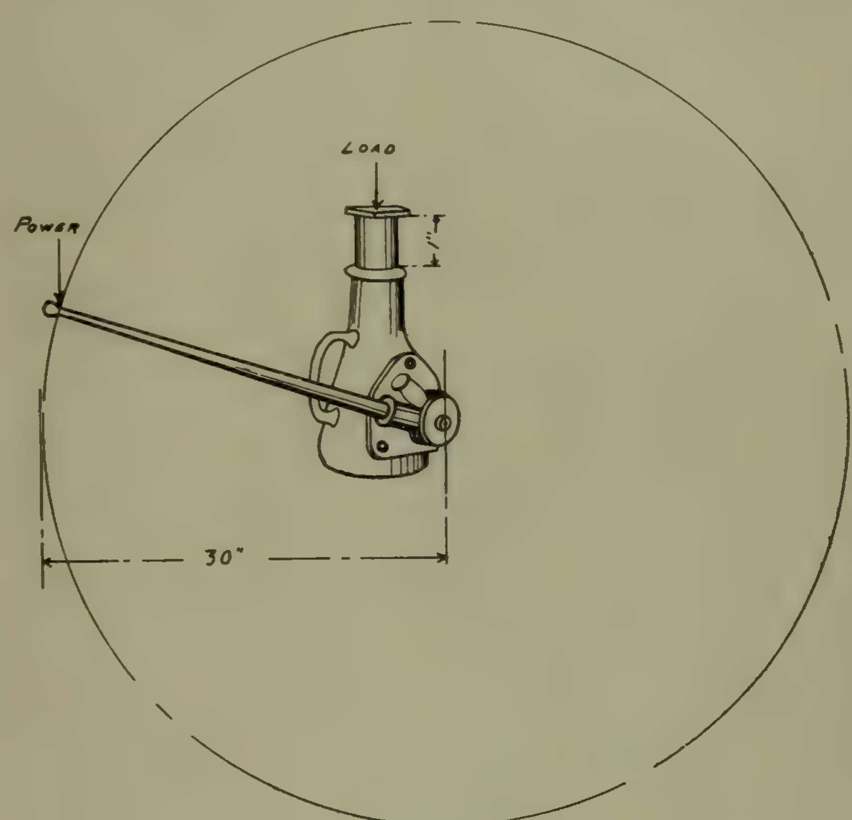


Fig. 1.

press and, in another instance, in a home-made air press. The jack to be tested was placed under the ram of the press and the ram brought down onto it with a slight load or pressure. The hanger for the weights was then suspended from the jack handle at the point the notch was made. The hanger and lead weights ordinarily used for counterbalancing driving wheels, with the addition of sufficient small pieces of iron to make the final tripping of the load, were made use of. The pressure was then allowed to accumulate until the gauge of the press showed the required load, when the weights were placed on the hanger until they just moved the load. About one inch was allowed for the weights to fall in tripping the load.

In the column headed "actual," which appears under the main heading "weight in lbs. balanced with a load of" is given the actual weight it took at the 30-inch distance on the lever to trip the respective loads of 10, 15, 20, 25 and 30 tons. In the columns to the right, next to the one just mentioned and headed "theoretic" are given the calculated weights, as figured from the formula $\frac{W \times P}{2\pi \times R} = P$, where W stands for the load on the jack, P the pitch of the screw, π, the Greek letter, representing the ratio of the circumference to diameter and equal to 3.1416, R the radius or length of the lever, and P the power or force necessary at the end of the lever to balance the load. Let us take a concrete example, using the quantities in test No. 1, with a load of 10 tons, the pitch of the screw in that jack being 4 threads to the inch. In

Test No	Make of Jack	Capacity of Jack in Tons	Weight of Jack in Lbs.	Where Test was made	Weight, in Lbs. Balanced with a Load of: 10-Tons Actual	10-Tons Theoretic	10-Tons Efficiency	15-Tons Actual	15-Tons Theoretic	15-Tons Efficiency	20-Tons Actual	20-Tons Theoretic	20-Tons Efficiency	25-Tons Actual	25-Tons Theoretic	25-Tons Efficiency	30-Tons Actual	30-Tons Theoretic	30-Tons Efficiency	Speed Strokes per 1" of Lift	Velocity Ratio Theoretic	Velocity Ratio Actual	Average Efficiency of Power	Average Efficiency of Speed
1	A-i	15	35	W	92	26.6	29	136	40	29½	220	53.2	24.2							40	752	940	27.5	80
2	A-i	"	"	W	82	"	32.5	134	"	29.8	220	"	24.2							40	"	"	28.8	"
3	A-r	"	45	W	83	"	32	143	"	28	174	"	30.6							40	"	"	30.0	"
4	A-r	"	"	W	64	"	41.5	115	"	34.8	169	"	34.5							40	"	"	36.9	"
5	B	20	50	W	77	"	34.5	124	"	32.5	167	"	32	234	66.5	28.4				45	"	"	32.3	71
6	B	"	"	W	55	"	48.5	103	"	38.9	157	"	34	229	"	29				45	"	"	37.5	"
7	B	"	"	C	93	"	28.6	174	"	23	217	"	24.5	238	"	27.9				45	"	"	26.0	"
8	C	25	35	W	61	53.3	87	86	79.7	93	143	106	74	193	13.3	69	268	159	59.5	20	376	470	76.5	80
9	C	"	"	C	108	"	48	159	"	50	181	"	58	277	"	48	393	159	40.5	20	376	470	48.9	"
10	A-c	20	"	C	186	26.6	14.3	213	40	18.3	285	53.2	18.7	358	66.5	18.5				40	752	940	17.4	"
11	A-c	"	"	C	135	"	19.7	228	"	17.5	285	"	18.7	358	"	"				40	"		18.6	"
12	A-b	"	37	C	163	"	16.3	197	"	20.1	273	"	19.5	359	"	"				40	"	"	18.6	"
13	D	15	44	C	161	30.4	18.6	196	45.5	23.2	232	608	26.2							36	658	846	22.7	74

Tests of Journal Jacks.

substituting these quantities for the letters in above formula we obtain the following: $\frac{10 \times 2{,}000 \times 1/4}{6.2{,}832 \times 30''} = 26.6$ lbs., which corresponds with the result given in the table. The third column to the right under the respective loads headed "efficiency" gives the efficiency of the jack, or rather of the screw, which is obtained by dividing the theoretical by the actual weights.

Under the heading "speed strokes per inch of lift are given the number of strokes of the jack handle it took, by pumping the handle between the horizontal and 45 degrees upward, which is about the natural movement performed by the workman in actual service, to raise the screw of the jack one inch.

Under the heading "velocity ratio" are two columns, headed "theoretical" and "actual." By velocity ratio is meant the relation between the space passed over by the power and load. It is figured as follows: The theoretic by counting the number of revolutions of the jack handle it took to raise the jack screw one inch and multiplying them by the circumference, in inches, of the circle described by the 30-inch radius of the jack handle. For instance, in the circle in Fig. 1, the actual weight is obtained by multiplying the length of the arc, in inches, of a 45 degree segment of the above circle by the number of strokes it took to raise the jack screw one inch. It may be well here to point out the cause of the actual velocity ratio being greater. By referring to Fig. 2, it will be at once seen that when pumping the ratchet at a normal stroke, which is, as mentioned before, through about a 45 degree segment, the pawl does not coincide with the ratchet wheel notches and, consequently, the upper notch will not be engaged but the pawl will slip and fall in the next lower notch on the downward stroke. Therefore lost motion occurs. The space has been passed over but

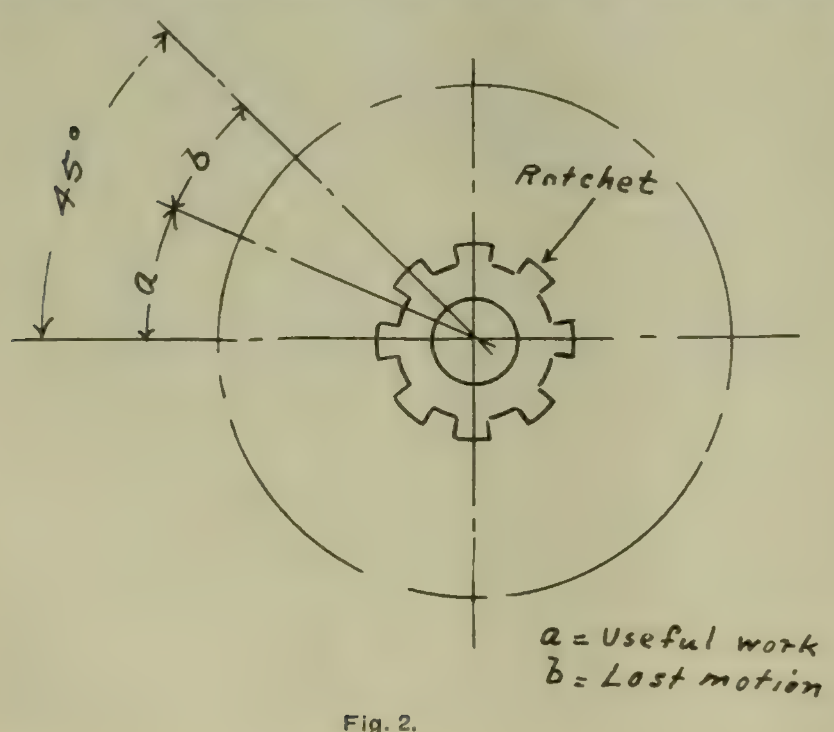


Fig. 2.

actual work has not taken place the entire length of the stroke—the coarser the notches the more lost motion.

In the last two columns are given the average efficiency of the power, more distinctly, of the jack screw, and of the speed of raising the load. The average efficiency of the power is obtained by averaging the efficiency of all the tests of each jack, and the efficiency of the speed, by dividing the theoretical velocity ratio by the actual.

As will be noticed by examining the table, the weight that was required to balance the same load, even with the very same jack, was considerably less at the locality "W" than at the locality "C." The reason for this is that at "W" an air press was employed for the testing, where at "C" a hydraulic press in good condition was used. The pistons—I say "pistons" as this air press is compounded so as to make it powerful enough for what it is intended—of the air press leaked around the leather packing and, although the gauge showed the tonnage corresponding with the pressure of air, the actual load on top of the pistons was less by an amount equal to whatever counter pressure there happened to accumulate on the under side of the pistons on account of the air leaking by the pistons. Consequently, the records taken at the locality "C" approach nearer accuracy, although, even in those there may be a slight error, due to the operator not being able to manipulate the hydraulic control valve in admitting the water pressure onto the ram to such a fine degree as to bring the load to the required point and maintain it. But for all practical purposes this method of testing is accurate enough, as the error is nominally slight. The main reason for resorting to the press as a means of loading the jacks was its simplicity and the obviating of any special apparatus.

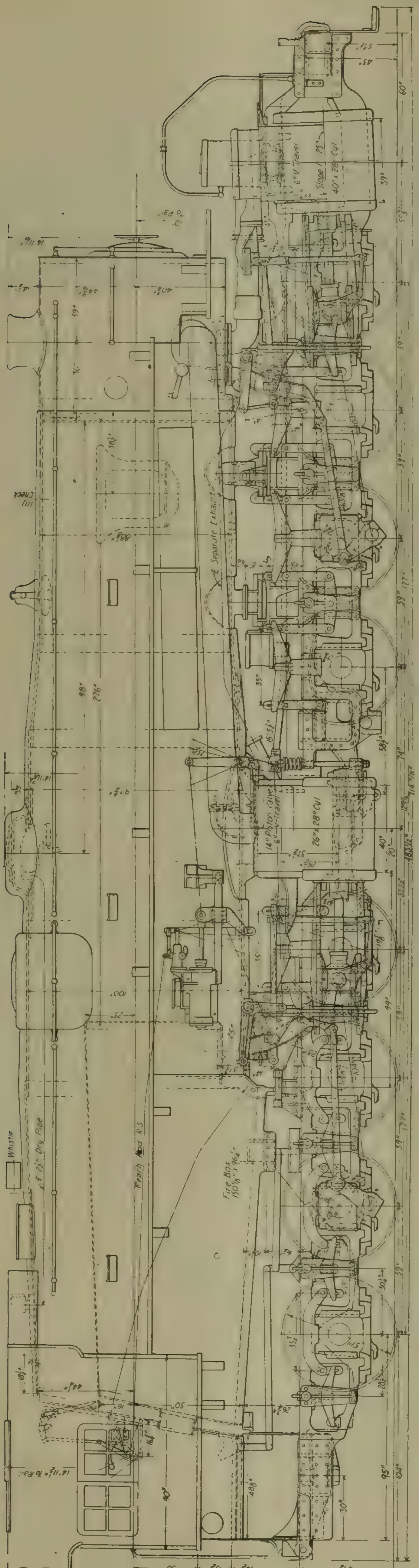
It will be noted that test No. 8 is altogether too high in efficiency for a screw jack, this being one of the tests made in the air press. Test No. 9 is the very same jack as test No. 8, but was made in the hydraulic press. The efficiency of 48.9 still seems unreasonable for a screw jack, this being a ball bearing jack. The writer believes that this efficiency (48.9) is not far from true, as repeated tests were made of this jack and they all came very near to this and, furthermore, the efficiencies of the other jacks are all quite in harmony, which further leads to the belief that it is true.

CAPACITY.

This quality, as applied to a man's ability to undertake and perform, is one of that class which is easy to observe, but difficult to define. Also it is a term frequently misapplied.

Its manifestation does not depend entirely upon mentality, nor yet upon physical or moral attributes. And yet, a man who is lacking in any one of these, is lacking in capacity.

The man of capacity is he whose mind has been broadened by observation and study, and whose habits of living and thinking have given him the moral and physical health to perform properly that which is set for him to perform.—*Brill Magazine.*



Elevation of Lake Shore Mallet.

MALLETS FOR HUMP YARD SERVICE.

Gravity or hump yard switching is constantly increasing in large and busy yards. At present there are ninety-five gravity switching yards on thirty different systems.

These yards represent an investment of many millions. Therefore as the road engine increases in size it becomes relatively important to provide means at these yards whereby the heavy trains may be economically handled.

When big road engines bring in their large trains it generally becomes necessary to devide the train before classification. This means more operating units and more congestion.

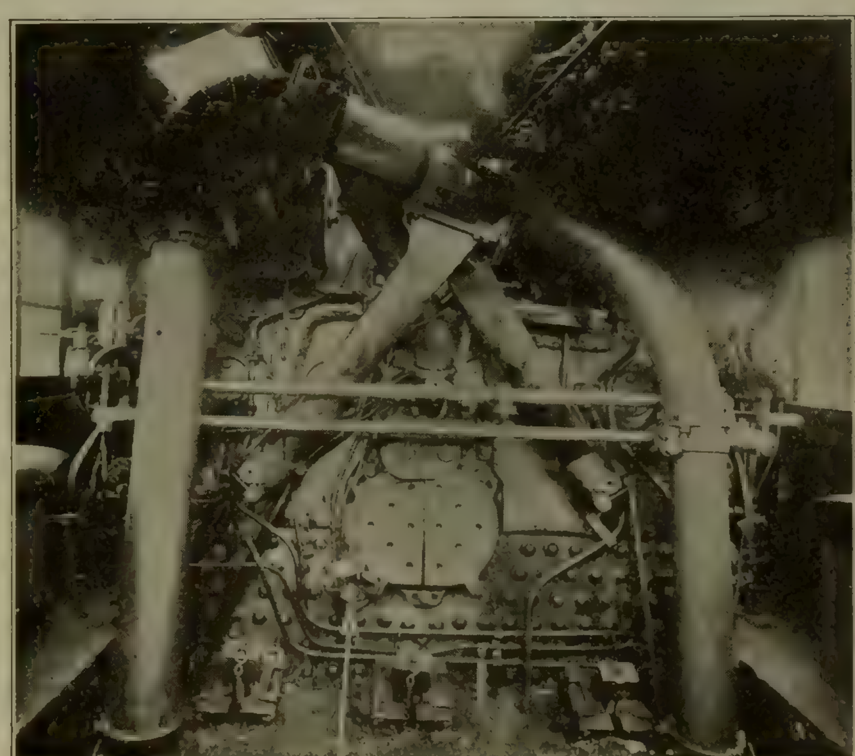
The average yard conditions as they exist today will not permit a long rigid wheel base. This is a severe limitation to the simple engine and restricts the design as to size and power. Mallet engines, with their drivers arranged in two independent sets, readily meet these limitations and also permit the designing of a locomotive powerful enough to handle the road train in one unit.

After carefully studying their conditions the officials of the Lake Shore & Michigan Southern placed an order with the American Locomotive Company for three Mallet engines for hump service.

Two of these engines are now in hump service at Elkhart and one at Air Line Junction. A. R. Ayers, general mechanical engineer, advises as follows: "We find that these engines will handle the same trains that the G-5 and G-6 engines bring into the yard. It was necessary to divide these trains in order to handle same with former power; this work was previously done by class M engines." Class G-5 and G-6 are heavy Consolidations. Class M is a ten-wheel switcher.

A comparison of some of the principle dimensions with the ten-wheel switchers supplanted shows some of the advantages of the Mallet for this particular service. The ten-wheel switchers have a rigid wheelbase of 19 feet 0 inches, the Mallets 14 feet 9 inches. Because of the many crossovers, this short rigid wheel base should be very desirable. The Mallet, with its tender, weighs 622,500 pounds. The ten-wheel switcher, with its tender, weighs 424,000 pounds. The Mallet has a tractive power of 100,500 pounds working compound, and 120,600 working simple. The ten-wheel switcher has a tractive power of 55,400 pounds. With only 47% increase in weight, the Mallet has 81½% greater tractive power working compound, and 117½% greater tractive power working single.

The boiler warrants special attention. It is a conical connected type and is 88 inches in diameter at the front end and 100 inches in diameter at the largest course. The barrel is fitted with 255 tubes, 2¼ inches in diameter, and 45 flues, 5½ inches in diameter and 23 feet long. The firebox is 150⅛ inches long by 94¼ inches wide, having a grate 121⅛ inches long. A Gaines combustion chamber combined with a Security brick arch and the railway



Back Head of Lake Shore Mallet.

Mallet for Hump Yard Service, L. S. & M. S. Ry.

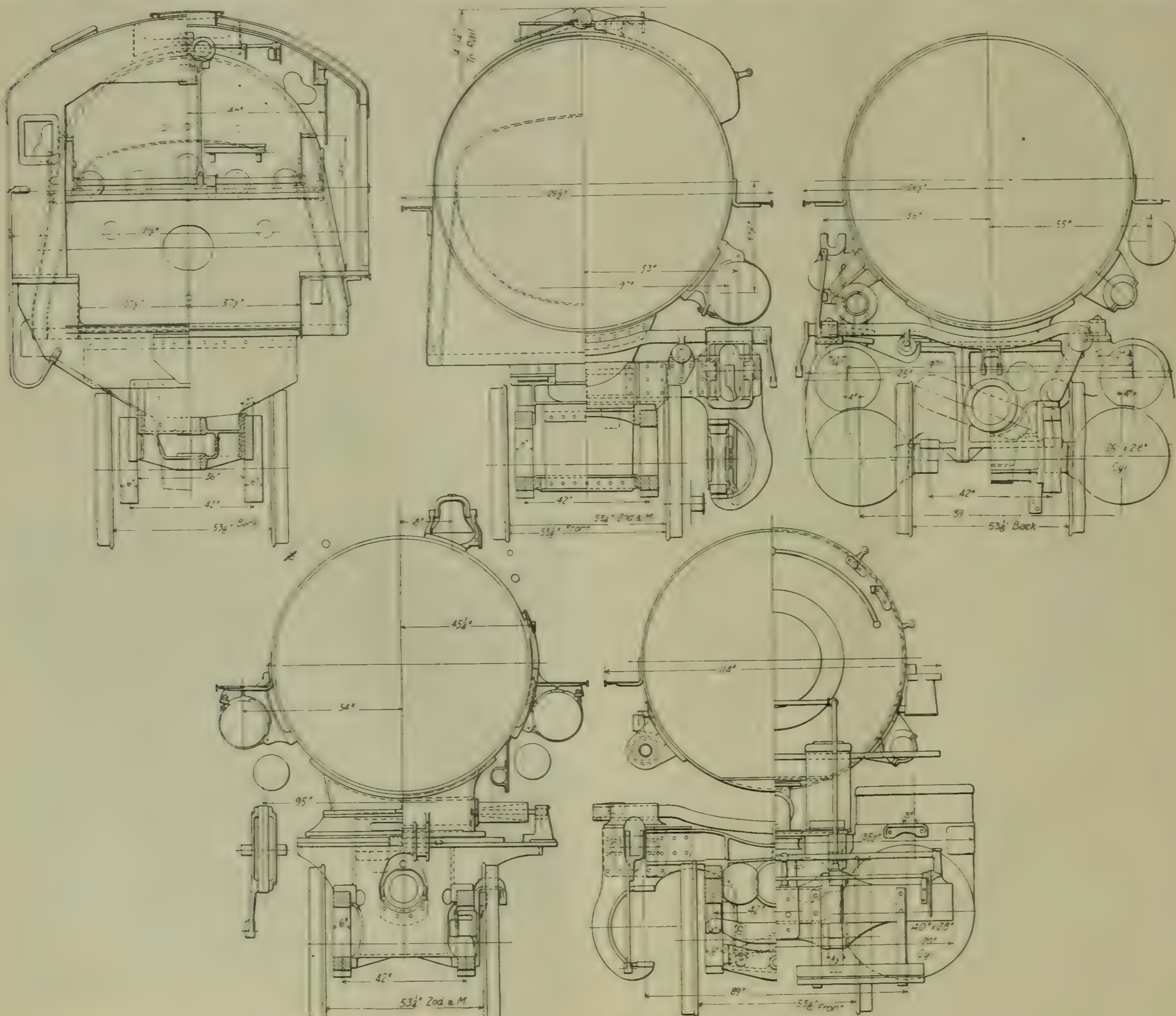
company's arrangement of combustion flues are also included. This firebox has a heating surface of 311 square feet with a grate area of only 81 square feet.

A novel feature is the arrangement for operation from either side. This was necessitated by the possibility of the engine being headed either way.

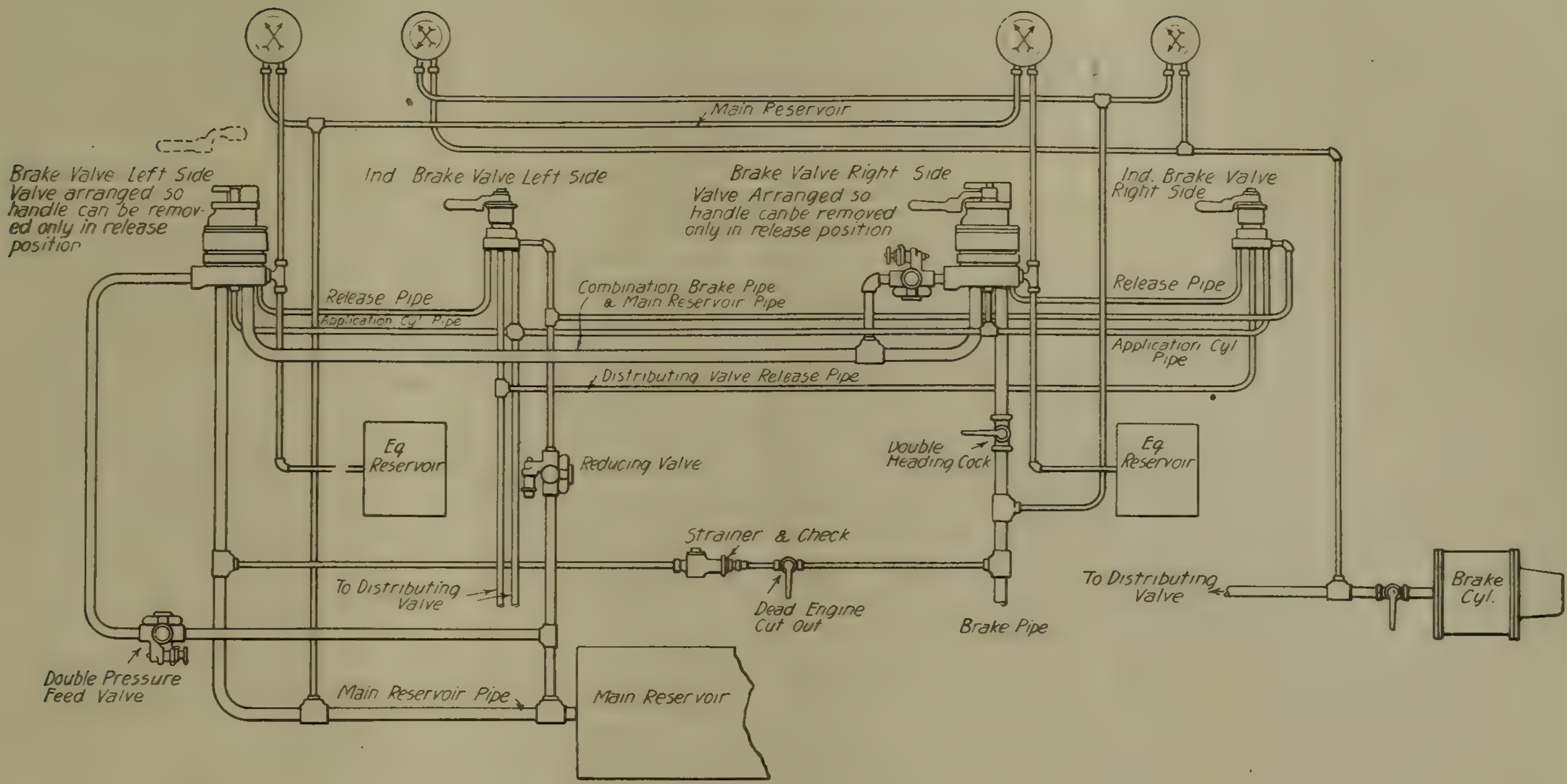
A specially designed bracket, one on each side of the engine backhead, holds the operating levers for the throttle and power reverse gear. Both throttle levers are clamped to a hollow shaft which extends across the backhead and operates the throttle by a series of cranks. The throttle lever on the right-hand side has a latch which locks on a quadrant. This latch is linked with the latch release handle which in turn is linked to the main handle and a crank. This crank is keyed to a solid shaft which passes through the main hollow operating shaft and is cranked and linked to the latch release handle on the left hand side. Thus either handle locks, unlocks and operates the throttle. A similar method is used in connecting the power reverse levers. Each side also has main and straight air brake valves with their gauges.

The Street stoker, radial buffer, Ragounet reverse gear and a pyrometer were also applied.

Additional strength with no increase in weight was secured



Sections of Lake Shore Mallet.



Air Brake Piping, Lake Shore Mallet.

through an extensive use of vanadium. The parts constructed of this material includes engine frames, driving axles, main and side rods, rod straps, eccentric cranks, driving springs, tender elliptic springs and crosshead keys. Cylinder castings were constructed of cast iron with vanadium content.

The table contain the principle dimensions of these locomotives:

Gauge	4'-8½"
Cylinders	26" and 40"x28"
Valves	Slide
Tractive power	simple, 120,960 lbs.; comp., 105,800 lbs.
Factor of adhesion	simple, 3.65; comp., 4.37
Boiler—	
Type	Conical conn.
Diameter	88⅛"
Working pressure	220 lbs.
Staying	Radial
Fire Box—	
Length	150⅛"
Width	96¼"
Thickness of sheets, sides	⅜"
Thickness of sheets, back	⅜"
Thickness of sheets, crown	⅜"
Thickness of sheets, tube	9/16"
Water Space—	
Front	4½"
Sides	4½"
Back	4½"
Tubes—	
Material	Seamless steel
Diameter	5½" and 2¼"
Thickness	5½", No. 9 B. W. G.
	2¼", No. 11 B. W. G.
Number	5½", 45; 2¼", 255
Length	23'-0"
Heating Surface—	
Fire box	311 sq. ft.
Tubes and flues	4924 sq. ft.
Arch tubes	54 sq. ft.
Total	5289 sq. ft.
Superheating surface	1235 sq. ft.
Grate area	81 sq. ft.
Driving Wheels—	
Diameter, outside	51"
Diameter, center	44"
Journals, main	10½"x14"
Journals, other	10"x14"
Wheel Base—	
Driving	14'-9"
Rigid	14'-9"
Total engine	40'-3½"
Total engine and tender	74'-4¼"
Weight—	
In working order	466,000 lbs.
On driving wheels	466,000 lbs.
Total engine and tender	622,500 lbs.
Tender—	
Wheels, number	8
Wheels, diameter	33"
Journals	5½"x10"
Tank capacity	8,000 gals.
Fuel capacity	14 tons.

WEIGHT AND SHRINKAGE OF CASTINGS

When castings in any particular metal are ordered it is often very necessary that the man who orders them should know their exact weight before they are made. Perhaps a certain amount of machining has to be done on them to bring them to an exact size, and consequently it is desirable to know to a certainty the amount of shrinkage that will take place in cooling. These facts are, of course, decided and calculated from the patterns supplied, but unless one has had very considerable experience in patternmaking or foundry work, such calculations might involve considerable difficulty, especially when castings in a variety of metals are required. Hence the following rules and tables may prove of assistance.

First of all, therefore, in ordering castings one must certainly know the relative weights of patterns and castings. This relative weight becomes rather difficult to ascertain when we remember the variety of woods in use for patternmaking, but the following table takes into account the woods that are chiefly used in this country. In column 1 of this table is specified the different woods from which the pattern might be made; in the other columns are factors by which the weight of the pattern must be multiplied to give the true weight of the resultant casting in the metal stated above the figure in question. Thus, if we wish to know the weight of a casting in brass, having given a pattern made in deal, we weigh the pattern, look along the horizontal line for deal until we come to

the column headed "Brass," and multiply this weight by the figure 18 found therein. Thus the weight of any casting may be found for any metal from a knowledge of the weight and material of the pattern itself:

Wood from which Pattern is made	Cast Iron	Zinc	Copper	Brass	Lead	Aluminium
	Multipliers for—					
Deal	17	15½	19	18	25	½
White pine	15½	14.8	18.2	17.5	24	5.4
Yellow pine	14.6	14.0	17.2	16.5	23	5.1
Beech	10.5	10.1	12.4	11.9	18.3	3.7
Baywood	13.2	12.6	15.5	14.9	20.4	4.6
Oak	8.5	8.1	10	9.6	13	2.9
Elm	13	11.5	15	14	20	4.5
Teak	9.5	9	11.5	11	14¼	3.2

The next important item to ascertain before ordering castings from any pattern is the amount of shrinkage that takes place while the metal is cooling. It is extremely important that this should be known, for a pattern made for castings in one particular metal is oftentimes unsuitable for castings in another metal if a definite size is required. It is because of this fact that cases have been known where a batch of castings have been supplied all of which have been considerably undersized, and on measuring up it his been found that insufficient material was left on the pattern to allow for shrinkage.

Even in making up patterns the amount of shrinkage that takes place must be allowed for, and therefore a good patternmaker must have the following figures firmly fixed in his memory. These figures show the amount of contraction that takes place per foot of material:

	In. per Ft.
Cast-iron cylinders (large)	3/32
" cylinders (small)	1/16
" pipes	1/8
" beams or girders	1/10
" " " " " (for heavy wheels)	1/10
Brass, thick	5/32
" thin	3/16
Zinc	5/16
Lead	5/16
Tin	1/4
Copper	3/16
Malleable iron	1/8
Steel	1/4
Aluminium	1/5

This list covers practically all that can be given, for any casting will in all probability show slight variation from the above figures, owing to the foundrymen, some of whom will give the mould a little more room than others. These figures, however, form a reliable guide.

One other item has to be considered, with regard to which one often hears the doubter expressing his ignorance by asking: "How much shall I allow on my castings for machining?" Of course it is impossible to answer this question exactly, for a great deal depends upon cleanness and fineness in casting; but average practice might help very many on this point. With castings in lead, zinc, or aluminium, it is always wise to leave at least ¼" all over, because these metals often contract very unevenly. There is no waste, either, in leaving this quantity of metal, because the excess is so easily melted down again for use in so many ways. The average rule for iron castings is to leave ⅛" all over, while for brass or copper casting 1/16" is enough. Castings in which twisting, whilst cooling, is likely to occur, require rather more than this allowance, while castings that can be regarded as small require rather less. In small cylinders ¼" in the diameter may be allowed for boring, but when the cylinder is as large as, say, 4′ in diameter, not less than ⅜" is required.

A little information might here be given regarding the pattern itself, for so much depends upon this in casting. First the pattern should have slightly rounded edges and filleted angles, for much of the strength in a casting depends upon the sharpness being taken out of all corners and angles. Sharp angles in a casting are always a source of weakness, and consequently only the patternmaker can supply the necessary strengthening by his filleting or his chamfer on the pattern. It is always wise as well to leave a slight taper on the pattern, about ⅛" per foot being all that is necessary, so that the moulder may draw the patterns out of his mould easily and without fear of breaking down this mould.

Holes for bolts, etc., may be "cast in" or "cored out." When cast in, sufficient taper must be given to draw the pattern, and the smallest size of the hole must be large enough for the bolt. When cored out a print must be put on one or both ends to form a support for the core, these prints projecting from ½" to 3", according to the weight of the core to be carried.

Lastly, to preserve and keep patterns in good order they should be varnished with a mixture of lampblack 1 part, shellac 5 parts, methylated finish 16 parts all by weight. The first coat should be rubbed over with glasspaper when dry, and the second then laid on.

If these instructions are adhered to, satisfactory and safe results will be obtained.—*Mechanical World.*

BETTER KEEP SMILING.

By Paul Dunbar in "Graphite."

If the day is sort o' gloomy
  An' your prospects are so blue
That you may be barely able
  To see your way quite through,
It won't help your chances any,
  Nor make your sight more clear,
To take counsel of your doubting
  An' surrender to your fear,
Anyway, you better jest keep on smiling,—
    I do.

Other people have their trouble,
  Though they greet you with good cheer,
Their sorrows may be double
  Those that come to you each year.
So I say, keep right on moving,
  Through the darkness an' the light,
He who guides us knows the pathway,
  He will always lead us right.
Anyway, you better jest keep on smiling,—
    I do.

S'pose your neighbor is more lucky
  An' secures an easy job,
While your work so overcomes you
  That your temples fairly throb,
It won't make your task the lighter
  If you grumble and complain;
Learn to smile when in the shadder,
  For there's sunshine after rain.
Anyway, you better jest keep on smiling,—
    I do.

So I'll end this little sermon
  With this couplet plain an' clear—
"You can't win success in future
  With the time you lose this year."
So don't stop to groan an' whimper
  At the foot of every hill,
Instead, keep climbing upward
  With the thought, "Of course I will."
Anyway, you better jest keep on smiling,—
    I do.

The Savannah & Statesboro has completed new shops at Statesboro, Ga.

The Seaboard Air Line and the Atlantic Coast Line will build a union depot at Bartow, Fla.

Pumping Locomotives

By A. G. Kinyon, Locomotive Fuel Engineer, Clinchfield Fuel Co.

In the present day of high operating costs and restricted rates, railroads must look to every possibility in the way of economy in operation and maintenance if they are to be, even in a measure, successful business propositions. Inasmuch as the cost of locomotive fuel is one of the largest items in the operating costs of railroads, it must be conceded that this item presents great possibilities in the way of saving. Much has been written on the subject of fuel economy generally and this article will only treat on that in so far as supplying water to the boiler is a contributing factor.

Boiler maintenance is also a considerable item of expense and any methods which reduce this cost in connection with fuel economy, if accompanied with increased efficiency, should be doubly pleasing.

Most men in positions in the mechanical department of railways, who have come into those positions by way of the scoop shovel and oil can route, thoroughly appreciate the possibilities of economy due to properly supplying water to the locomotive boiler. Others in these positions who have not had the privilege of firing and running a locomotive are less apt to appreciate the importance of giving this subject careful consideration.

Water can be supplied to a boiler only with the expenditure of energy. It matters not whether the manner of supplying it be a pump or an injector, considerable power must be expended.

The writer commenced firing a locomotive in the days of the old cross-head pump. With the introduction of the injector men were inclined to practices acquired in using the pump and which gave unsatisfactory results in connection with the injector's use. In some cases these practices were entirely wrong when applied to an injector as a means of feed water supply. With a pump the supply of water to the boiler ceased when the locomotive came to a standstill. This brought about the practice on the part of many of the old-time engineers of setting the "lazy cock" of the pump so the water would be kept at an exact height when the engine was working. Of course, when the engine stopped the supply of water stopped and any water put in while drifting had a chance to warm and get into circulation while the engine was standing. They would also gauge the opening of the lazy cock so there was always room for putting some water in while drifting, which was a good thing. This, however, led to a practice with the injector of setting the water valve at a capacity which would permit of the injector being worked continually without getting too much water in the boiler, even though the stops were in some cases of considerable length. Sight was lost of the fact that while standing the water introduced had not the forced draft of the exhaust and the using of the steam to get it hot and in circulation. The result was that in pulling out after a stop the pressure would drop back materially and it would require the best efforts of a skillful fireman to regain the lost pressure, and oftentimes this was not accomplished at all, or was accomplished just before the throttle was closed for the next stop. As a result the pops would lift and the amount of water thus lost would be almost if not quite as much as would have been put in while standing at the station.

Every gallon of water in a locomotive boiler when starting over and above the amount necessary to protect the fire box and flues, up to the point where dry steam is insured to the cylinders, represents stored-up heat; heat to be drawn upon for efficiency in cases of emergency; heat to be drawn upon for economical purposes if no emergency arise. From the above it will be readily admitted that we should have every gallon of water in the boiler possible when starting and still insure dry steam. The pressure should also be at the maximum without the pops opening.

The engineer, being familiar with the road over which he is to handle a train, and knowing what stops and shut offs will be necessary, should figure in advance of the run the proper method and time of pumping. If an engine is not too full of water to start a train it is not too full to commence putting in water as soon as the train is under motion and the lever hooked up. It does not necessarily follow that the injector should be put to work at once. Circumstances must determine this. If it happens to be a local passenger run, where the stops are frequent, it may not be necessary to put the injector at work until about to shut off for the next station. If such a course is possible the engineer should instruct the fireman not to hurry the fire in pulling out, but to keep the pressure near the maximum. If the injector is put to work just before the throttle is closed, and set to full capacity the boiler can be filled up to the desired level before starting again and still shut off soon enough before the start is made to have the water warmed up and in circulation when the throttle is again opened. It should be borne in mind at all times that water put in when the boiler is not being called upon to supply steam to the cylinders is put in much more cheaply than when working steam. If the run is to be a long one before shutting off and possibly very severe the injector should be put to work as soon as the pressure is near the popping point and before the pops lift. The fireman should see that this pressure is had by the time the lever is hooked up to the running cut-off and the engineer should not wait for the opening of the pops to warn him that it is time to put the injector to work. The injector feed should be so adjusted that water will gradually be lost. The engineer knowing the road and the run should be able to so make this adjustment that the water level will have dropped to about one gauge on a level road when the throttle is closed. If the distance or the time before the next opening of the throttle is short the fire pressure should be maintained right up to the time of shutting off. Just before the throttle is closed the injector should be set to full capacity, and if necessary to keep the pops from lifting the second injector should be put to work, but shut off as soon as the conditions are such as to insure the pops not lifting. The feed of the other injector should then be cut down if the pressure commences to fall. It should be shut off altogether soon enough to allow the water to get thoroughly warmed up and in circulation before the throttle is again opened. On a hilly or mountainous road where the train will roll down one side of a hill but requires severe work of the locomotive to make the up-grade, care must be exercised to see that so much water is not introduced while coming down the hill as to interfere with getting good results when the angle of the boiler is reversed on the up-grade. On some locomotives one gauge of water on the down-hill will become three gauges when climbing the hill on the opposite side. In this case if we were to put in two gauges on the down-hill run we would work water on the up-grade. The above conditions must always be taken into consideration when topping a summit. If the water is allowed to get low when making the ascent, though ample to protect the sheets with the rear of the boiler lowest, there will be danger of damage when the summit is passed and the angle of the water level reversed.

Some men, boiler makers particularly, will object to the introduction of an abnormally large quantity of water as suggested. Their contention is that the cooling effect will tend to contract the sheets suddenly and cause the seams and flues

to leak. This will not be the case if the quantity is reduced as the pressure commences to fall. The writer followed this practice for many years while running an engine and never caused a firebox leak thereby. Some experiments recently made at the experimental station of the Bureau of Mines at Pittsburgh show that the temperature of the boiler sheets on the fire side is practically the same as that of the water on the other side. In fact, the difference in temperature is found to be so slight that it is measureable only with the most delicate instruments. From this it is obvious that the matter of harm to the sheets will occur only when the water is introduced in such large quantities that the steam pressure will fall.

It is the practice of some engineers, particularly with a poor steaming engine, to put water into the boiler faster than it is being used. This for the purpose of having a surplus which will permit shutting the injector off to allow the steam to pick up. Closing the injector under these circumstances is a signal to the fireman on many roads to rake the fire and thus encourage the objectionable practice of raking. While this shutting off of the injector allows the pressure to pick up, in the long run it will result in a loss of water and steam and many times cause a steam failure or it will at least be reported as such when in fact it is a man failure.

In many cases with poor steaming engines or with good steamers in very severe service, a fireman can keep up the pressure if the injector is set to lose a little water as outlined above, instead of gaining on the level. This enables satisfactory and economical work to be accomplished, even under adverse conditions.

In superheater locomotive practice there is a tendency to carry water too high, on account of the fact that with high water the superheater will be converted into an auxiliary steam generator and water will not be thrown out of the stack and strike the engineer in the face. The benefits of the superheat are lost, however. The application of the pyrometer to superheated locomotives is a safeguard against this improper practice.

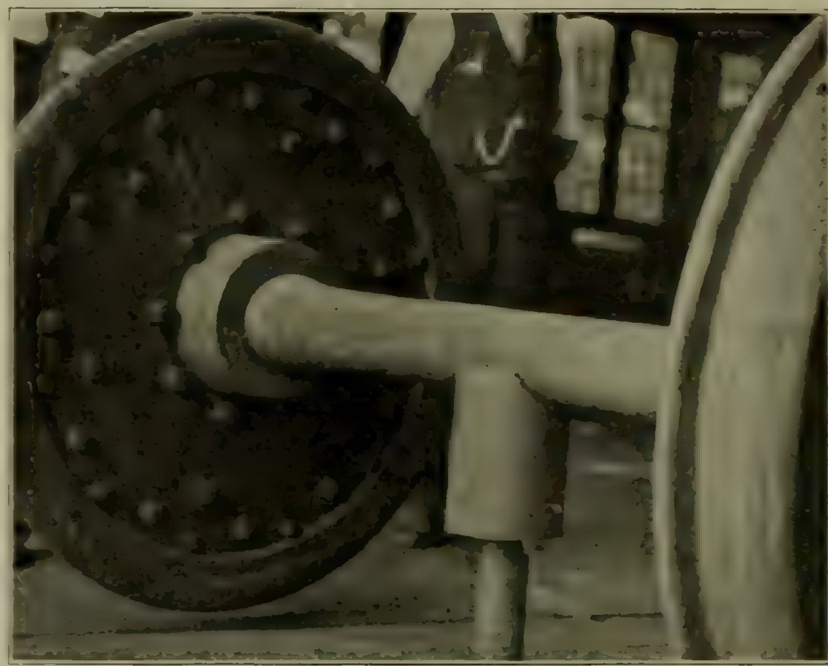
In filling up boilers at terminals where the engine is to have the fire cleaned or knocked out, great care should be taken to put in all the water that will be necessary up to the time of again firing up, before the fire is worked. Putting large quantities of water into a boiler directly after the fire has been removed causes more injury to firebox sheets and flues than any other one thing.

The same methods that make for fuel economy in the operation of a locomotive under favorable conditions, that is, good steaming qualities, fair service and proper use of steam, if followed with a poor steamer or in excessively hard service will certainly make for efficiency.

AIR HOIST FOR WHEELS.

By W. T. Walters, I. C. R. R.

While engaged in the installation of a large wheel lathe the necessity arose of having some method of handling wheels at the intersection of storage tracks. The ordinary industrial turntable being too cumbersome and expensive, the following simple device was designed: A 10" brake cylinder was placed in a wooden box below the surface and piped to the nearest air line. Into the hollow piston rod a smaller rod 2¼" in diameter was dropped. The end of this rod carries a revolv-

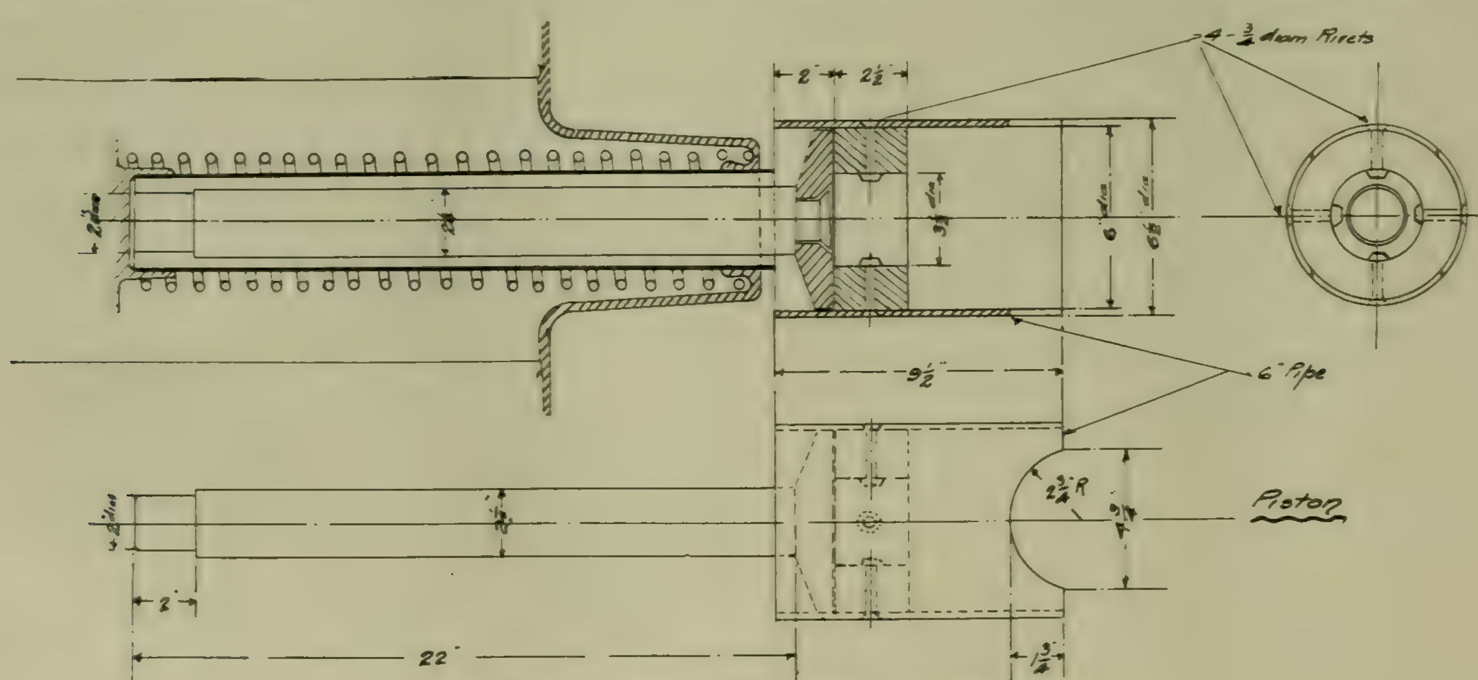


Air Hoist for Handling Wheels.

ing head 6" in diameter. A piece of 6" pipe was then taken and grooved to suit the radius of car axles. Inside the pipe a collar was fitted, being riveted in position. This being dropped over the movable piston rod provides the necessary head for handling axles. The wheels being run over this arrangement, air is admitted and it is found that the least touch is sufficient to cause wheels to spin around. These proved such a success that they were adopted in other parts of the shops.

The Central of Georgia has awarded a contract to the Southern Engineering & Construction Co., Macon, Ga., for a viaduct in Macon, Ga. Grading for the new yards at this point has been completed.

The Chicago & North Western has commenced work at Clinton, Ia., on a new repair yard of 180 cars' capacity, a mill 60 ft. by 150 ft., shop 50 ft. by 100 ft., and other facilities, which will be erected at a cost of about $85,000.



Piston Rod and Revolving Head for 10" Air Hoist.

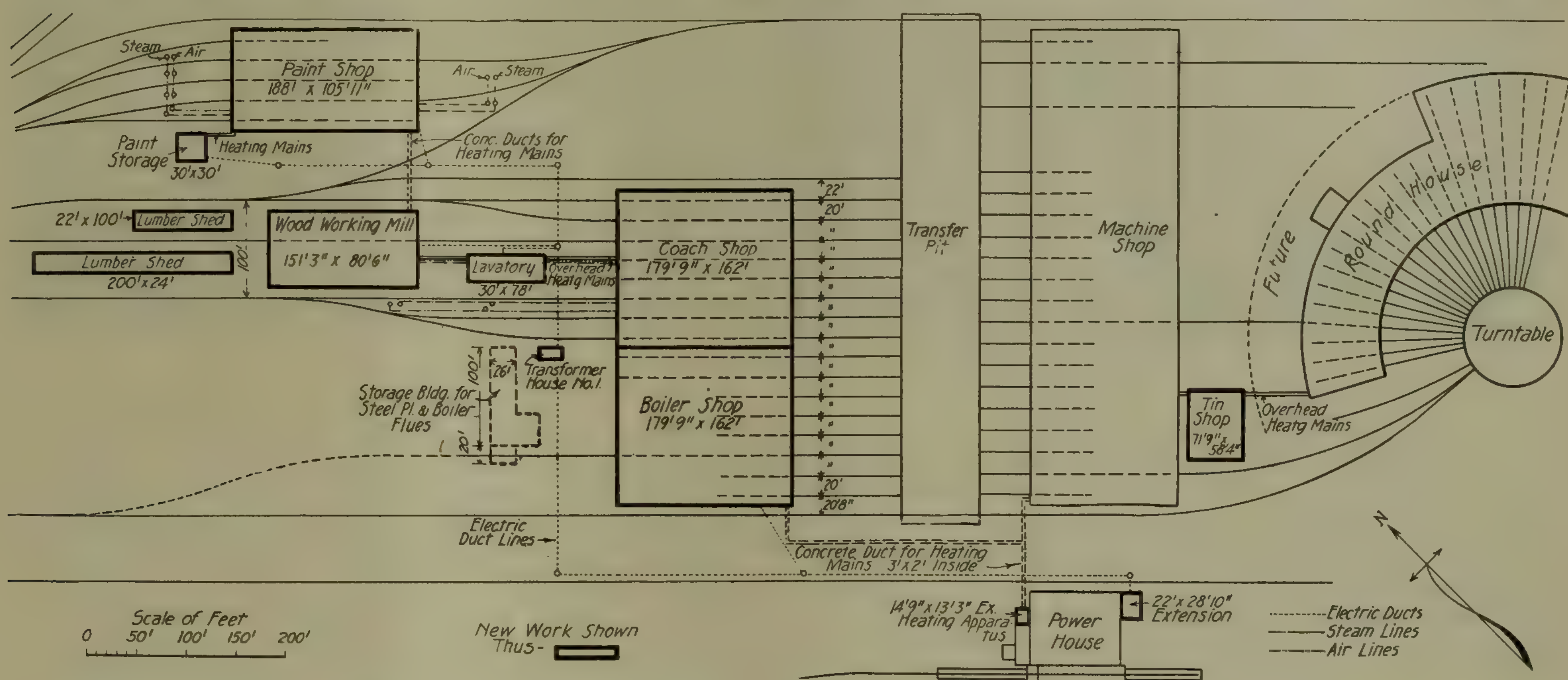
SHOP BUILDINGS FOR THE OREGON SHORT LINE AT POCATELLO, IDAHO.

Pocatello, Ida., is the principal division point on the Oregon Short Line and the principal shops of the system are already located there. The new buildings being built are to increase the present facilities which are inadequate.

These buildings consist of a combined coach and boiler shop, wood working mill with lumber storage sheds, paint shop with independent building for storing materials, tin and copper shop, transformer house and independent toilet building. The cost of the above buildings and facilities exclusive of tools is in round numbers $300,000.00.

The general plan herewith shows the position of these new buildings relative to existing structures.

The water supply is obtained principally from springs located about four miles west of Pocatello, the water being pumped from the springs to a reservoir on the side of the mountain so that the mains at the shops are under about 300 foot head. This head provides fire protection. Drainage for the new buildings is provided by a sewer system which was installed several years ago.



Layout of New Shop Facilities of Oregon Short Line at Pocatello, Idaho.

All electric lighting and power lines are carried in conduits under ground, the power being transmitted at 2200 volts to the transformer house, from which the power circuits are carried at 440 volts and the lighting circuits at 220-110 volts.

The electric power is furnished by the Twin Falls & Great Shoshone Light & Power Co. from its American Falls plant, the railroad company however maintains a reserve steam plant, which plant also furnishes heat for the buildings.

The shop yards are to be lighted with incandescent lamps and the lighting system arranged so that nitrogen filled lamps can be used.

Both the design and construction of this work is being executed under the direction of Carl Stradley, chief engineer of the Oregon Short Line Railroad. The Lynch-Cannon Engineering Company of Salt Lake City are the general contractors.

COACH AND BOILER SHOP.

This building is approximately 180 feet wide by 324 feet long and divided in the middle by a brick fire wall extending above roof. One end of the building is used as a coach shop and the other end as a boiler shop.

As shown on the general plan this building is located adjacent to the present transfer table so that this table will be available for use in connection with this building.

The combination coach and boiler shop is peculiar. However, in designing this building it was intended primarily as a boiler shop, it being intended to convert the entire building into a boiler shop at some future date when conditions warrant, other provisions to be made for a coach shop at that time.

The cross section of the building is divided into three heights as shown in the interior view herewith. The left portion is 70 feet wide and 40 feet high with a 50 ton traveling crane running lengthwise of the boiler shop. This clearance is provided so that one locomotive boiler can be lifted over another, if necessary, by the crane. In the high portion of the coach shop a balcony 60 feet by 70 feet is provided, 22 feet above the main floor, to be used as an upholstering and cabinet shop, a one ton hand power elevator being provided for handling material.

The central portion of the building is 35 feet wide by 33 feet high and is provided with a 15 ton traveling crane running the entire length of the building, a door being provided in the fire wall to allow the crane to pass through. This crane is intended to do the lighter work in the boiler shop and also be available for use in the coach shop to facilitate the handling of trucks.

The low portion of the building on the right as shown in the illustration is 70 feet wide and about 20 feet high. This part of the building is intended for the light work which does not require high overhead clearances and the use of cranes. The building has concrete foundations, brick walls and steel frame, the balcony

Interior of Coach and Boiler Shop.

Coach and Boiler Shop from North. Toilet Building at Right.

floor being of reinforced concrete. The roof is constructed of 2" T. & G. Oregon fir and covered with Johns-Manville Brooks brand asbestos roofing and the under side of roof is painted with Johns-Manville fire proof cold water paint. The interior view shows this construction well, excepting the cranes and crane girders which are not yet installed.

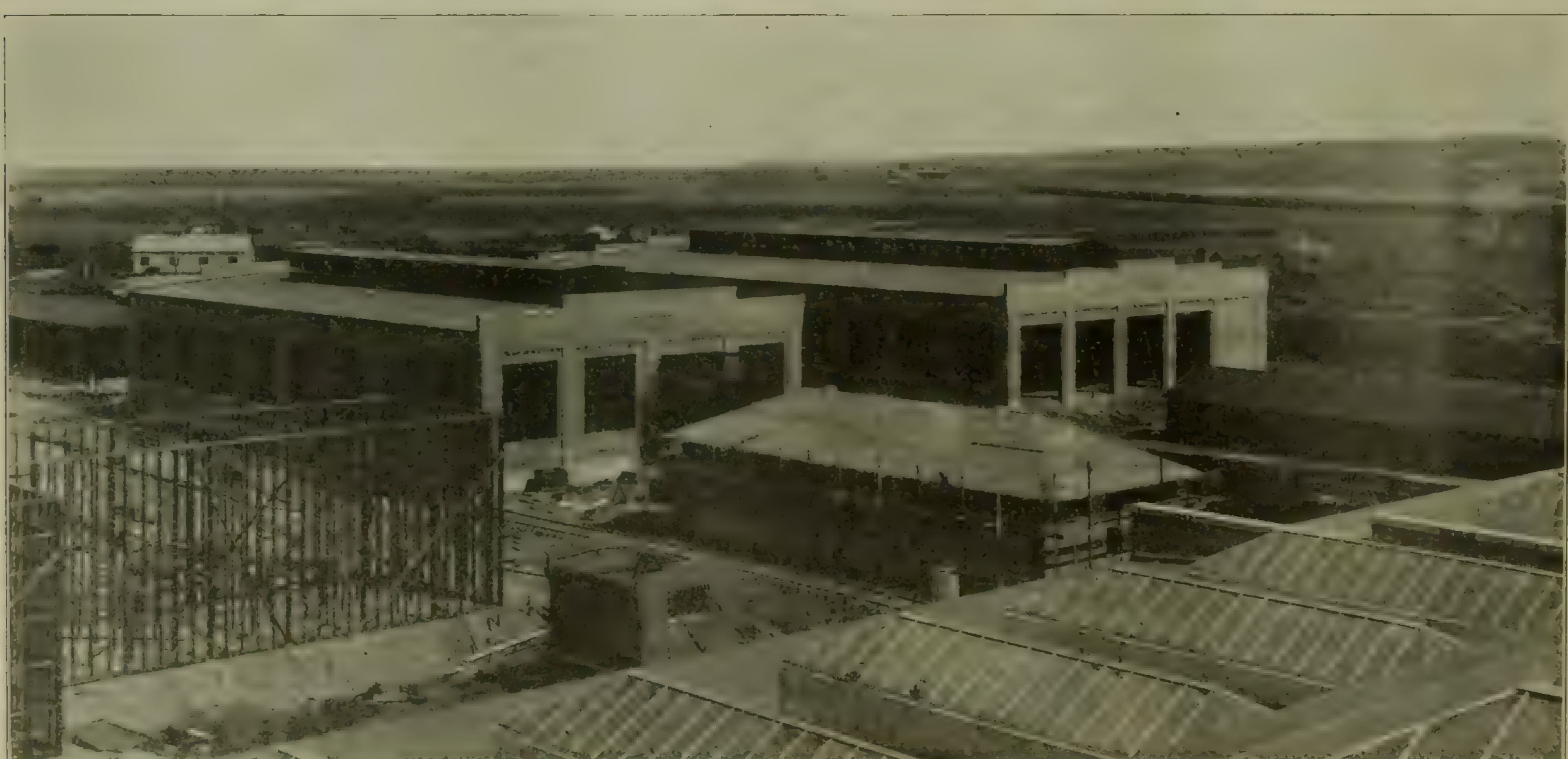
The natural lighting of this building has been well taken care of, the style of the building being particularly adapted to this feature. Note in the illustration the large area of glass both in the walls and roof. All sash except the skylights are provided with sash operators so they can be opened from the ground and thus provide ventilation.

The artificial lighting is taken care of by means of electric incandescent lamp clusters of 800 watt capacity well distributed throughout the building. The system is so designed that the new nitrogen lamps can be used. Outlets are provided at convenient points so that portable lamps may be plugged in.

The heating system is different from that usually used in such buildings, being a forced circulation hot water system. This system has the advantage over the usual steam heating system in that the temperature of the water in the radiators can be regulated to suit the weather conditions and that the water is forced through the system under pressure thus making the system absolutely positive. This system is known as the Coogan hot water system and is being intalled by the Coogan Engineering Co. of Salt Lake City.

Live steam, air and water hose connections are provided at convenient points throughout the building for purposes of testing, etc.

With the new boiler shop, in addition to present facilities, it is



Paint Shop at Right. Woodworking Mill at Left. Picture Taken from Roof of Coach and Boiler Shop.

estimated that 30 locomotives per month can be overhauled in the combined shops in addition to the usual light repairs made in the roundhouse. It is also estimated that the coach shop will provide sufficient facilities to take care of the usual repairs to 32 coaches per month.

PAINT SHOP.

This building is approximately 106 feet wide by 188 feet long and contains four tracks, which traverse the entire length of the building, and one stub track. Each of the long tracks will accommodate, within the building, two of the longest coaches without crowding.

The class of construction is the same as that used in the coach and boiler shop, the same method being used to provide proper light, heat and ventilation.

A separate building 30'x30' constructed of brick and concrete has been provided for storing paint materials.

Steam, air and water connections are provided at convenient points both inside the building and adjacent to the tracks running into the building. These are provided to facilitate cleaning coaches as well as testing the heating systems of the coaches and the air brakes.

The floor of this building is of concrete and slopes to drains so that the coaches can be washed down within the shop. This, of course, is not intended to displace the usual coach cleaning yard. It is estimated twenty-seven coaches per month can be turned out by this shop.

WOODWORKING MILL.

This building is 80'x150' of construction similar to the preceding, the same methods of lighting and heating being used.

Two lumber sheds are built adjacent to the wood working mill for storage of materials. One of these sheds is 24'x200' and the other 22'x100', one on each side of the track which runs through the mill, as shown on the general arrangement plan.

TOILET BUILDING.

Instead of locating toilet rooms in each building, one toilet building was provided and centrally located, relative to all of the new group of buildings. This building is 30'x80' of brick and concrete construction and contains the most modern sanitary fixtures. The central toilet was decided on because the first cost was less than for the same facilities in separate toilets and that one entire building for this purpose could be more easily taken care of than separate toilets for the different buildings. This building will be in charge of an attendant who will look after same.

In the picture this is the low building with the steep roof in the middle of the picture.

The frame buildings shown in the picture were built for temporary use and will be removed.

The small brick building with roof not finished is the transformer house.

TIN AND COPPER SHOP.

This building is 58'x71' and designed along the same lines as the other shop buildings, and is to be used for sheet metal work only. The location of the building is on the opposite side of the machine shop from the other new shop buildings.

SEVENTY-TON COAL CARS.

The illustration shows one of the eleven 70-ton self-clearing coal cars recently built by the Standard Steel Car Company for the Standard Car Truck Company. Ten of these cars are assigned to the Erie Railroad. The main feature of the car is the four-point bearing double action truck. This style of truck has been thoroughly tested under several flat and ore cars during the past six years. The car body and load is supported at the center line of the truck side frame by a special radial roller device which works in harmony with the Barber lateral motion roller device, now in general use on a large number of freight cars and locomotive tenders in the United States and Canada. The cast steel truck side frames are a special I-beam drop girder type. The truck springs are the M. C. B. standard for 35-ton, arranged in four groups of two, for each frame; two groups on the outside of the web of the frame and two on the inside; all equalized into proper bearing by spring caps and a spanning roller seat. The truck bolster is a 24-inch rolled steel I-beam placed horizontally and serves only in taking switching shocks and carrying the center pivot castings. The angle cross ties of the truck extend through openings in the side frame and are riveted on both sides of the web to the flanges of the frame.

The journals are 6x11 inches. The wheels applied are of three different makes, for comparative wearing test; two of forged steel and one of cast steel. The journal boxes are arranged with shims for raising car when wheels are turned. Brake beams are supported by removable brackets attached to side frames.

The two sides of the car body form girders which carry the entire load, there being no intermediate or center sills.

The body bolster and end sills form the cords of a wide girder which receives the draft attachments. The cast steel pedestals which are attached near the ends of the body bolsters are fitted to and interlock with the crown face of the radial roller cap.

The car is 42' 9½" over buffer castings; 10' 0" extreme width, 10' 6¾" extreme height, 9' 3" inside width; cubic capacity, 2,646 feet.

The car is equipped with the following specialties:

Seventy-Ton Hopper Car.

Enterprise Railway Equipment Company's lumping mechanism.

Miner friction draft gear No. A-18.

Simplex couplers.

Blackall ratchet hand brake.

McCord journal boxes.

New York air brake.

Creco brake beams.

Bronze Metal Co.'s journal bearings.

Carmer ''pull-up'' type uncoupling device.

One of these cars will be on the exhibit track at the Atlantic City convention.

HYDRAULIC RIVET SHEAR.

By E. T. Spidy, Assistant General Foreman, Canadian Pacific Ry.

This machine was designed to meet a condition met with in many boiler shops, in fact in almost all locomotive boiler shops, namely, to provide facilities for shortening rivets or patch bolts when required in special lengths for patches in repair work. Our modern boiler shops are provided with heavy machinery of all kinds for handling plates and boiler sections with every economy, yet to shorten a dozen rivets usually is an expensive job because it does not pay to hold up a large shearing machine to put in proper blades, as the regular shear blades do not make a good job besides damaging the blades. Also it involves somebody taking these dozen rivets to a bar shear in another department and usually waiting around until they can be put through or else leaving them and coming back later, which entails an equal amount of waiting to the gang.

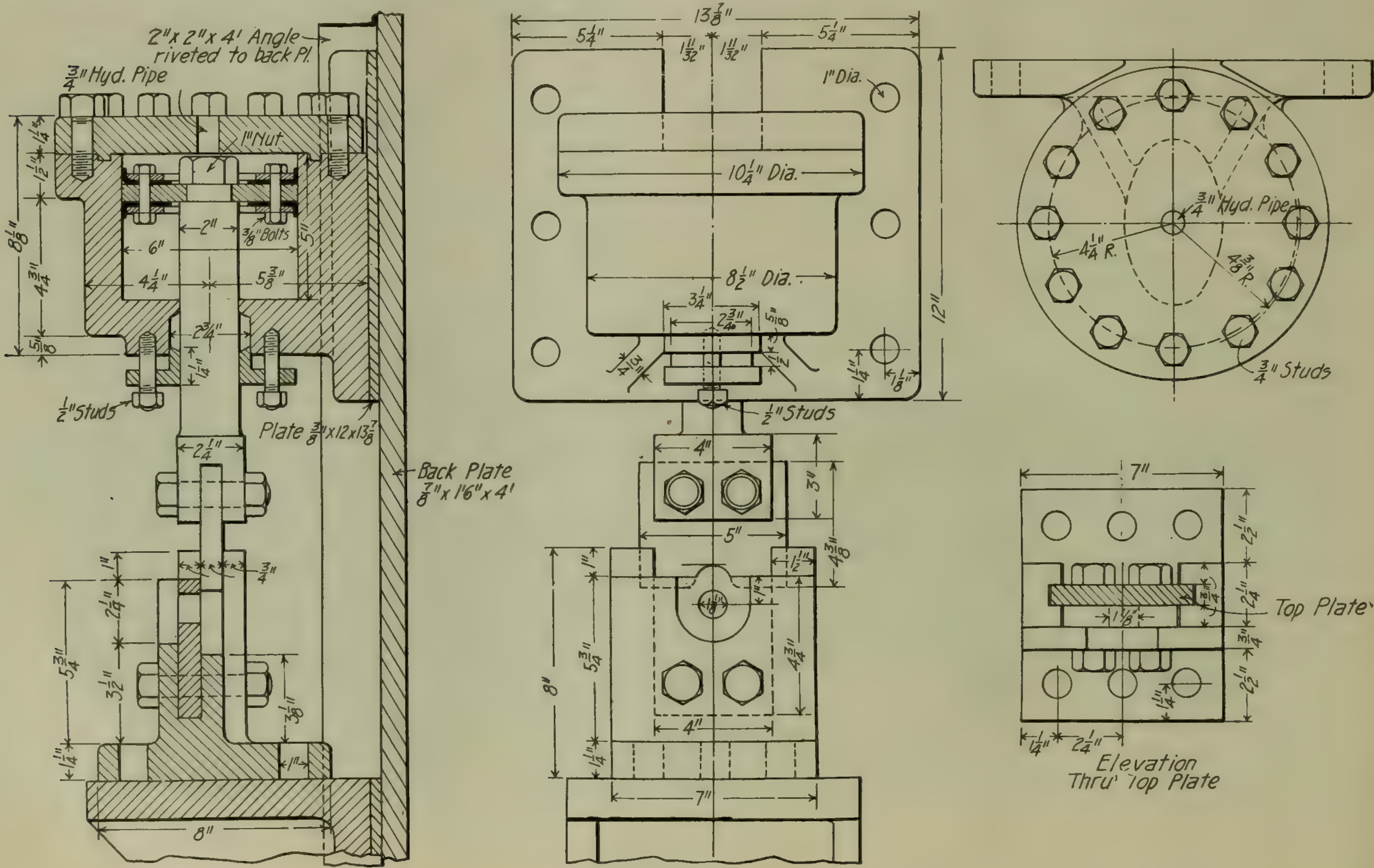
Many air operated shears have been designed and do good work but they are all somewhat large and take up valuable space, whereas a hydraulic shear such as required for this purpose can be attached to a shop column or pilaster and be out of the way of everything and yet be ready at all times.

The machine illustrated was designed to cut off rivets up to 1⅛" diameter and to cut them off as short as ¾". With a hydraulic pressure of 1,500 pounds per square inch it was found that a 6" diameter cylinder was necessary. The cylinder was made with but one cover, thus avoiding one joint, the piston rod gland being formed on the bottom of the cylinder. The top blade holder is formed directly on the rod and the piston is bolted on the rod with a pinned nut. The bottom blade is held rigidly in a special casting which has grooves for the top blade to move in. When the whole is bolted up, the top blade never leaves these guide grooves, thus any rotation of the piston is prevented. The top blade works behind the bottom blade and the rivets to be sheared are placed through a hole in the bottom blade. Hydraulic pressure is connected to both ends of the cylinder and operated entirely by one four-way valve. Our machine has been in operation about nine months and has given eminently satisfactory results, saving much time and making a good clean cut every time. It involves no personal danger whatever, which is more than can be said of any other method.

THE BALTIMORE & OHIO has asked its agents to acquaint those entrusted with the enforcement of the law with the facts pertaining to the loss of life due to trespassing. The authorities are being asked to co-operate with the railroad in the campaign it is conducting, to the extent that when tramps, unlawful train riders and others are apprehended they be taken in charge by the agents of the law. Suggestions are being requested from the authorities consulted and their recommendations will be forwarded to the railroad officials for due consideration.

THE TRAVELING ENGINEERS' ASSOCIATION will hold its annual convention at the Hotel Sherman, Chicago, Ill., on September 15, 16, 17 and 18, 1914.

The Louisville & Nashville has ordered 1,500 tons of steel rails from the Tennessee Coal, Iron and Railroad Company. This rail will be used in improvement work on the North and South Alabama division of the line.



Hydraulic Shears for Rivets.

Springs for Railway Equipment

By A. L. Graburn, M. E., Canadian Northern Ry.

When considering the subject of "Springs," as applied to rolling stock, and especially in so far as it is dealt with from the railway operating engineer's standpoint, it is well to bear in mind that the proposition can be successfully dealt with, if proper thought and serious action is taken. For more than two years the Canadian Northern has been constantly on the lookout for spring failures with the idea of checking up results in service with those obtained theoretically. The greatest trouble found at first was caused by not having full information as to the specific requirements, and as it had come to be common practice to substitute springs in a general way, so long as it fitted in place, it was evident that no proper or reasonable check could be obtained.

Operating men seem to consider the spring question as one of the ever troublesome conditions which has to be borne with utmost patience, and where failure occurs in a certain class of spring the tendency most always is to increase the thickness of the plates, without regard to other conditions. So far as coil springs are concerned, fairly uniform results are obtained, while the exact opposite is true of elliptic springs.

It is not significant to learn that the highest responsibility rests with the spring maker, and with him, reasonably speaking, rests the power of turning over a finished product of capable capacity to hold a specified load. No spring should ever be applied to any car or locomotive without first being tested and tagged, to meet specifications. So much is written concerning special spring steels and, oftentimes, it seems a difficult question to answer whether or not better results are obtainable from a low carbon as compared with a high carbon steel. From practical results it is evident that the Pennsylvania analysis steel with .90 to 1.10 carbon content meets requirements, generally better than other grades. This steel has an elastic limit of 160,000 pounds.

Practically all of the low carbon steel is made in England and Europe, having a carbon content of .50 to .70. We are able to obtain the same elastic limit in both steels in view of the fact that the former is tempered in oil and the latter in water. We have used both grades and it is a fact that the high carbon steel does not require the great amount of refinement incident to that of hardening low carbon steel. This is one of the main reasons why on a road where it is necessary to make repairs to springs in small shops located at divisional points, better service is obtained from high carbon steel.

The confidence that can be gained for uniform results in service of springs as a reliable piece of apparatus, is due principally to improvements in mechanical details which permit of it doing the work for which it was intended. Springs are used in equipment on account of their flexibility, and in so far as this feature is followed out we have a mechanism fulfilling its purpose perfectly. The object of every equipment engineer ought to be focused on the fact of having the leaves as nearly of uniform material ⅜" thick as possible, for when ½" leaves are used it is certain good results cannot be obtained. The adoption of a standard number of leaves for any class of spring should not be allowed without regard for the load. This refers especially to 36" double-elliptic coach springs, as it is general throughout the country to specify a combination of either five leaves 4" wide with 3" width of band or six leaves 4" wide with 4" width of band. This has its greatest fault in that a very stiff spring is obtained for specially heavy equipment, such as observation, dining and baggage cars. Under our new standards it has been necessary for us to increase the number

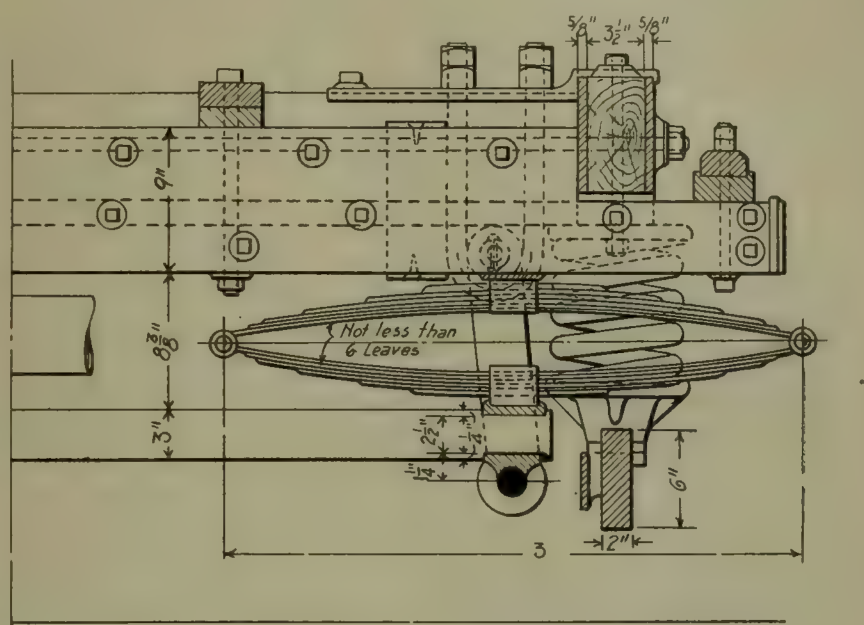
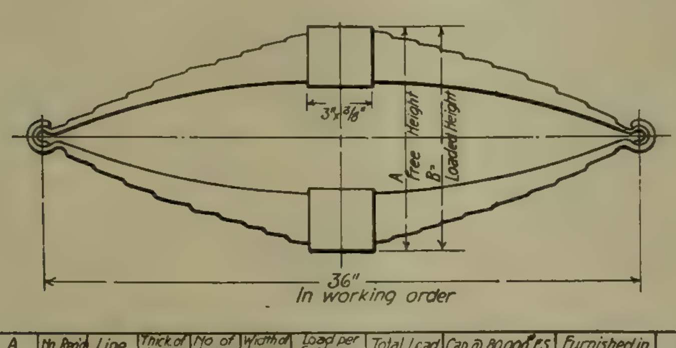


Fig. 1.

of leaves from six leaves to a total of ten leaves in many cases before good results were obtained. The adoption of such practice has caused a modification of the design of wooden passenger coach trucks in several instances in order to gain sufficient clearance for a larger spring. For instance, on a number of cars having 3" oak spring planks, as per Fig. 1, we substituted a 12"x25" channel (see Fig: 2), which gave us 2½" extra depth for springs. All of our specifications for tender and coach springs, as well as full-elliptic equalizer springs for locomotives, require that ends of plates to be rounded off on top extreme outside edge (they are not to be tapered or have corners cut off) and ends are wrapped without taper or offset. This is given in Fig. 3, in which may be noted especially the standard length of plates on six-ply springs. If springs are five-ply no



B	A	No. Req'd	Line	Thick of Leaves	No. of Leaves	Width of Leaves	Load per Section	Total Load	Cap. @ 80,000# F.S.	Furnished in	Location
11"	15½"	4 Set	1	⅜"	10	4"	7,500#	15,000#	9,080# per Sect.	Doublets	Platform End
12¼"	16¼"	4 Set	2	7/16"	10	4"	11,580#	23,160#	12,360# " "	"	Baggage "

Truck Springs, C. N. R.

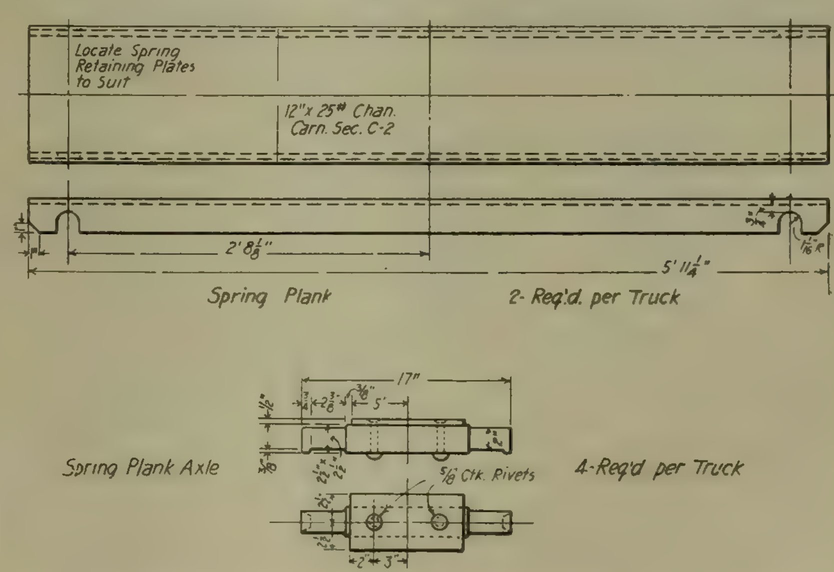
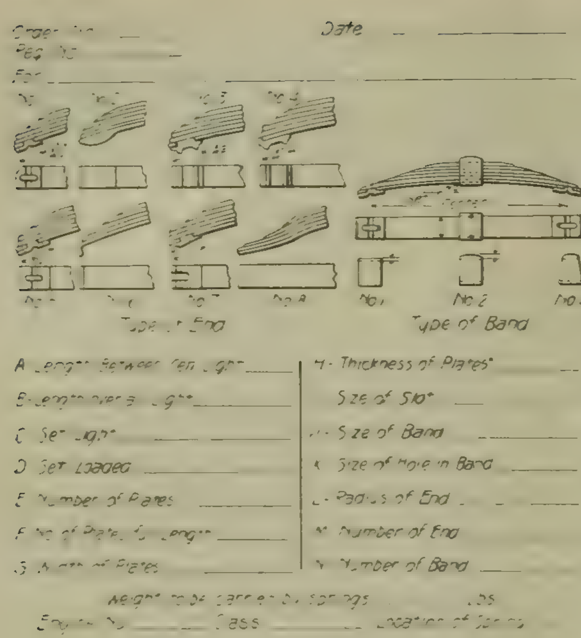
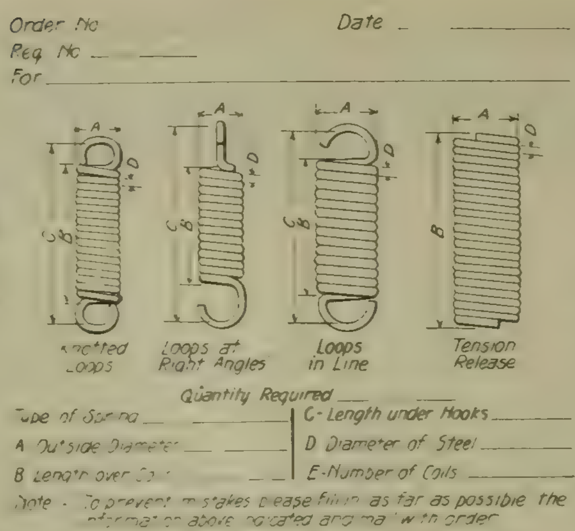


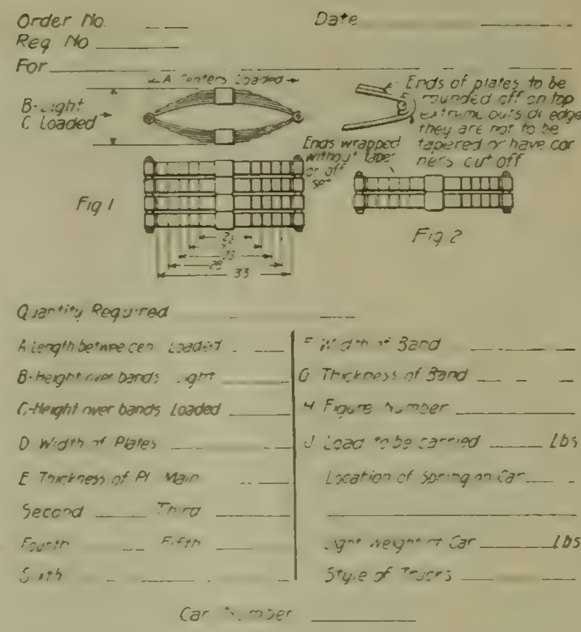
Fig. 2—Spring Plank and Hanger for Pullman No. 5 Truck.



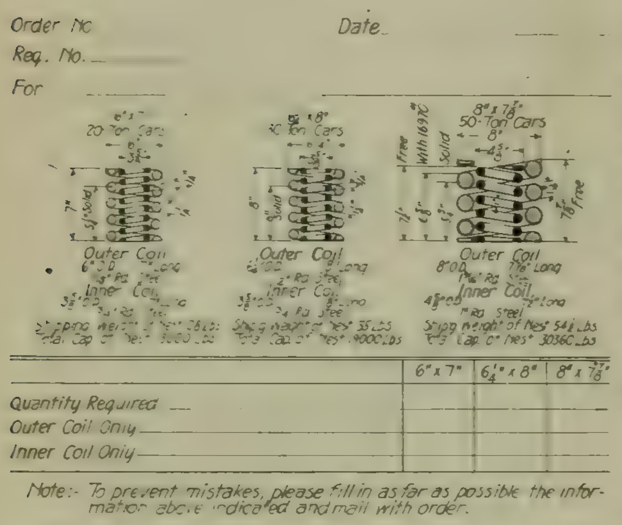
Half-Elliptic Springs.



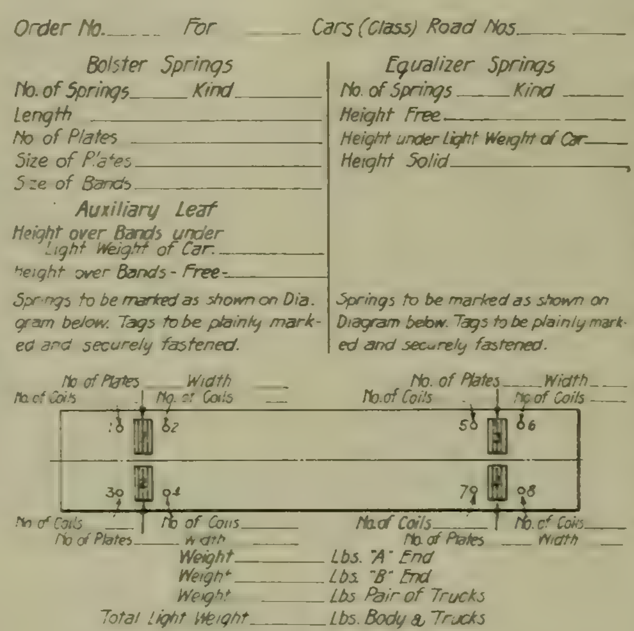
Tension Coil Springs.



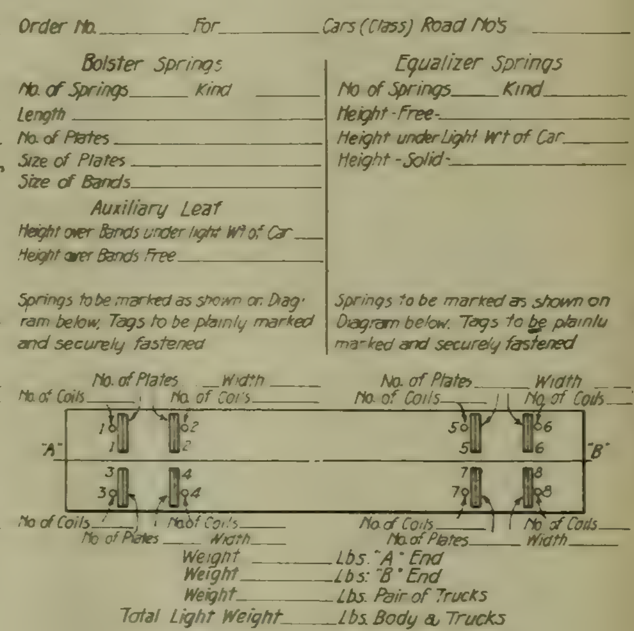
6-ply Full Elliptic Springs for Passenger Cars.



Standard Draw Bar Coil Springs.



Spring Specifications, Four Wheel Trucks.

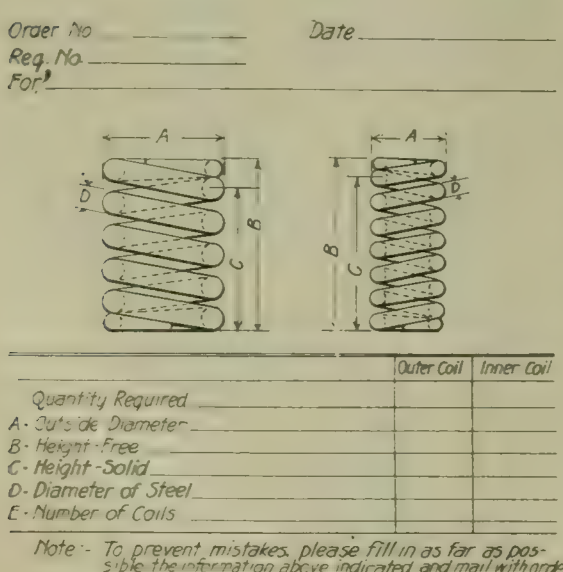


Spring Specifications, Six Wheel Trucks.

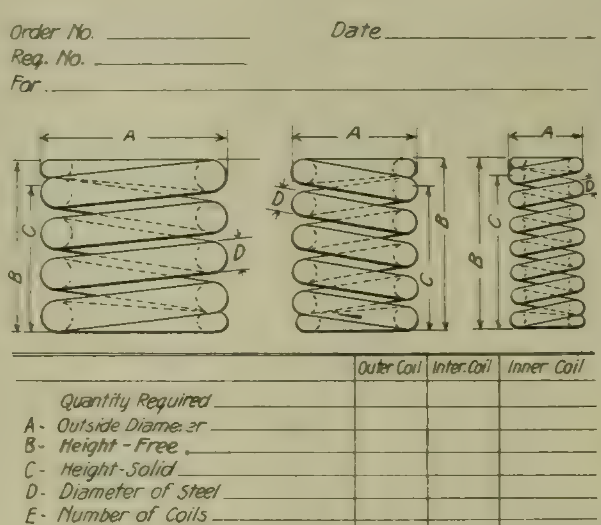
change is made in length of five inner leaves, the two short plates are simply removed.

The illustrations show a number of our standard forms covering all designs of springs and tables for complete orders of coach springs. One copy of the order form is sent to the purchasing department and another copy to the mechanical engineer. What is necessary to overcome trouble in a case of this kind is to get the information and design a spring to meet the job and then see that it is tested to meet the requirements. When we started out on this subject the opinion was generally that it was an impossibility, but today we are master of the situation, but it is impossible to convey the great measure of work it has required to get things lined up on a matter of this sort.

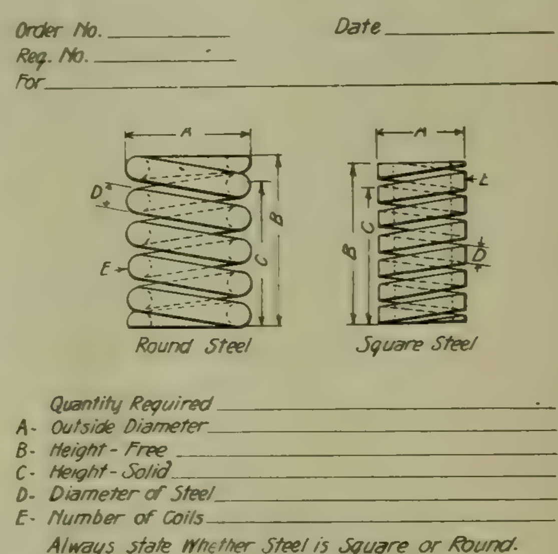
Our standard formulae assume for elliptic springs the principle of two cantilever beams of uniform strength where the total load is divided and supported equally at each end. The length of arms is the length from support to edge of the band.



Double Coil Compression Springs.



Triple Coil Compression Springs.



Single Coil Compression Springs.

For computing the safe load and deflection of elliptic and coil springs we take fiber stress at 80,000 lbs. per square inch and the modulus of elasticity at 25,400,000 lbs. per square inch.

To find the safe-load capacity of semi-elliptic and full-elliptic springs having all leaves graduated, as shown on details, we use the formula

$$P \text{ — } \frac{2 S n b h^2}{3 L}$$

For example, take a full-elliptic coach spring, 36″ centers, six leaves 4″ wide, ⅜″ thick bands 4″ wide, we have:

$$P = \frac{2 \times 80{,}000 \times 6 \times 4 \times .141}{3 \times 32} = 5{,}640 \text{ lbs. or safe load.}$$

S = Maximum fiber stress in spring or 80,000 lbs.
E = Modulus of elasticity or 25,400,000 lbs.
b = Width of leaves or 4″.
n = Total number of leaves or 6.
h = Thickness of leaves or ⅜″.
L = Net length of spring, i. e., actual length between centers of bolts, less width of band or 36″ — 4″ = 32″.

In the case of coil springs we will assume a drawbar spring having an outside diameter of 8″, diameter of bar 1½″. How much will it carry? It must not close under the maximum static load, but it may close entirely by the jerk caused by coupling, and it therefore assumes that the unit shearing stress in periphery of cross section amounts to 60,000 lbs. for the maximum static load, assuming the elastic limit to be 160,000 lbs. unit stress.

From the formula

$$W = \frac{40 Z d^3}{100(D-d)}$$

where — Z = Unit shearing stress in periphery of cross section.
d = Diameter of bar.
D = Diameter of coil outside.

$$W = \frac{40 \times 60{,}000 \times 3{,}375}{100\,(8''-1.5)} = 12{,}461.54 \text{ lbs.}$$

A RELIC OF OTHER DAYS.

By H. M. Perry.

A study of the standard box car of fifty years ago is particularly interesting at this time, owing to the gradual disappearance of the wooden car and substitution of the steel underframe or all steel car.

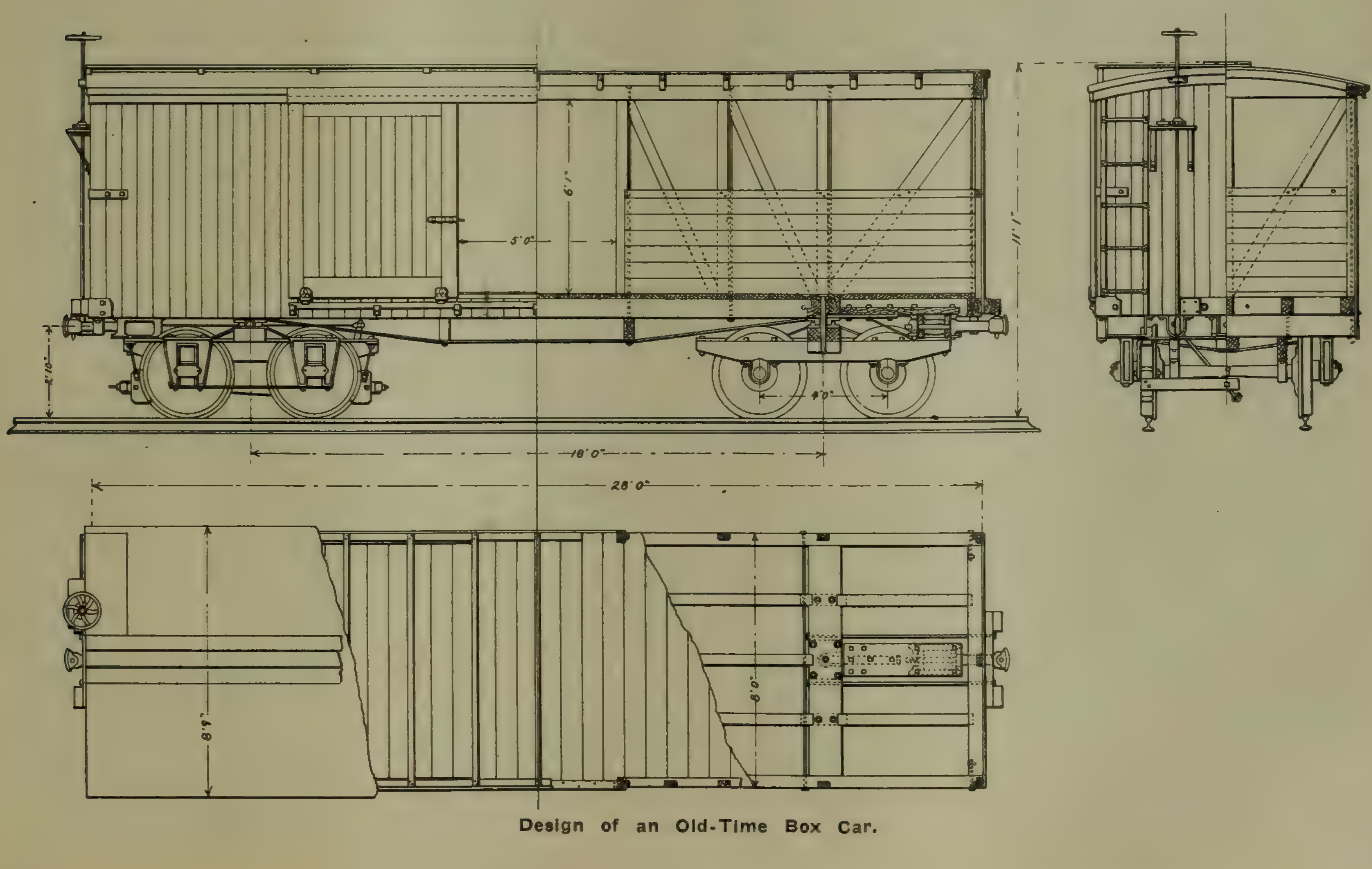
In comparing this old ten-ton capacity car with our present standard of forty-ton car, one is surprised at the slight difference in the general design of the two cars, the material in the modern car simply being strengthened to meet the requirements of heavier traffic.

The first radical departure from the old design was the extension of the center and intermediate sills from end to end of the car, the application of long truss rods, and the rigid attachment of drawn gear to the under side of the center sills, thus strengthening the underframe and substituting a substantial draw gear. These were practically the only changes which have been made from that time to the present, except in enlarging and strengthening the material as the capacity of the car was increased.

In the old design the draw gear consisted of a three-inch by twelve-inch oak plank with cast iron cheek pieces bolted to the under side of the plank; cast iron followers were arranged to operate in guides on the sides of the cheek pieces and a rubber spring about five inches in diameter by seven inches long was placed between the followers. The coupler had a one and three-quarter inch tail pin cast into its neck and extended back through the followers and spring and was secured by a wrought iron key and cotter.

The entire gear was suspended between the bolster and end sill and secured in place by a one inch by three inch wrought iron bar, bolted to the under side of the plank and extending back into the body bolster on top of the center plate, the end of the bar being enlarged and punched out to take the king bolt, the whole draft of the train being carried by the king bolts. The front end of the gear was supported by a carry iron, forming a pocket around the neck of the coupler, and bolted to the under side of the end sill.

When the draw gear was damaged, which usually occurred



Design of an Old-Time Box Car.

every few trips, it could be removed by simply taking out the king bolt, dropping down the carry iron and lifting out the entire gear, when a new one was substituted, the whole operation requiring only about fifteen minutes, as new or repaired gears were always carried in stock.

The principle cause of failure of this gear was the rubber spring, which frequently burst or split in two, even after they were strengthened with wrought iron bands forced on the outside of the spring.

About this time the flat steel spiral springs came into use to replace the rubber and the spring trouble vanished, but the draw gear troubles increased; instead of breaking the springs, the cast iron cheek pieces, or followers, were broken or the whole gear knocked out from under the car. The dead woods which were placed on the outside of the end sills to take up the buffing shocks, before the springs were exhausted, did not seem to answer the purpose or prevent the increased damage, so when the center sills were run the length of the car and the draw timbers bolted to them it was believed that the final improvement in draw gear had been reached, and when we consider that this same design was followed for over forty years, simply strengthening the parts as required, we must concede that a long step forward had been made in car construction,

In the old design of underframe the body bolster was of the same thickness as the width of the side sills, and was framed into them with a mortice and tenon. The three intermediate sills only running between the bolsters, with two short sills between the bolster and end sill. Cross tie rods were placed back of the bolsters, also two tie rods running from the end sill back through the bolster.

The truss rods or straps were made of flat iron one-half inch by two and one-half and were bolted to the under side of the side sills at the bolster and extended down under the cross tie timbers, the ends of the straps having gibs which were morticed up into the sills.

As the side sills were the only members of the underframe extending the whole length of the car and were weakened by the large mortices at the bolsters, they invariably failed at this point. In many instances, with the older cars of this class, when an engine started with a sudden jerk the body would break in two at the bolster, taking the bolster, end sill and one truck with it and scattering the lading along the right of way.

In the new design of underframe the bolster was reduced in thickness from seven to five inches with lips three and one-half inches thick extending out under the side sills, the intermediate and side sills being gained out one and one-half inches where they passed over the bolster.

Each bolster was provided with two seven-eights inch truss rods running over the center sills and bent diagonally down through the intermediate sills and bolsters, the ends provided with nuts and washers. This plan was followed for a number of years until the trussed wrought iron bolster was introduced which has been in use until within the last ten years, then being superceded by the various designs of cast or pressed steel bolsters in present use, all of which seem to be doomed by the introduction of the all-steel underframe.

Another feature of the old car was the design of the roof. The rafters were sawed out of two-inch oak plank, cut on a circle, with a rise of about six inches, each rafter being three inches wide and lipped on to the plate, the two rafters at the door posts being provided with joint bolts through the plate to hold the roof together. The rafters were covered with seven-eighths-inch sheathing laid lengthwise of the car and protected with ordinary roofing tin, each sheet being cleated down and soldered together, the running board was secured by cleats soldered to the roof.

As the tin roofs were easily damaged by the brakemen walking over them, causing leaky roofs, galvanized iron was substituted for the tin. The sheets were cut of sufficient length to reach from side to side of the car, the edges were provided with interlocking grooves, one sheet being locked to the next, and the ends nailed down over the edge of the eave moulding. This design of roof was followed by the double board roof, the inside iron roof and the various kinds now in use.

The side doors were framed out of two-inch oak, the stiles and rails being mortised together and secured by joint bolts at the corners, the panel being of seven-eighths-inch sheathing. The bottom of the door was provided with cast iron shoes sliding on a three-eighths inch wrought iron track. The top of the door sliding in a groove in the top door guide.

As the bottom tracks were easily bent, the first improvement was made by suspending the door on wrought iron shoes sliding on an over-head track, which was soon followed by the introduction of rollers in place of the shoes, the different forms of which are in use now. About the time that the doors were suspended from the top, the Batten door came into use and has been the standard form of door since that time. Several designs of flush door have been tried out, but none of them have proved entirely satisfactory.

The standard truck under this old car was of very simple construction. A bar of one-inch by three-inch wrought iron was bent into almost a perfect square and securely welded at one of the corners. Cast iron pedestals were bolted to the sides of the frame to receive the oil boxes, the wheel centers being spaced four feet apart.

On the upper side of the frame, between the wheels, was placed a wooden bolster five inches thick by twelve inches wide and supported at the center by a flat truss strap bolted to the under side of the bolster near the ends and running down under a block at the center. The bolster was provided with the ordinary center plate and roller side bearings of a pattern which has not entirely disappeared at the present time.

Under side of the bolster and just inside of the wheels, was placed the safety beams extending from end to end of the truck and securely bolted in place, and a yoke extending down under each axle was bolted to the under side of the beams.

The wheels and axles were of very light construction, the wheels being single plate and the journals three and one-quarter inches diameter and five and one-half inches long. The bearings were brass shells filled with Babbitt metal and the truck springs rubber, placed over the oil boxes in the pedestals.

The brakes on this car were only applied to one truck. The brake heads were sawed out of four-inch oak plank and a wrought iron shoe bolted to the head. The brake beam was of white oak four inches thick by seven inches wide at the center, tapered towards the ends and mortised into the brake heads and secured by joint bolts, but was not provided with truss rods. The inside brake beam had a wrought iron brake jaw to hold the brake lever, to the lower end of which was attached one end of the connection rod, the other end extending through the other brake beam with nuts and washers on both sides of the beam, the thread on the rod being cut a sufficient length to allow the slack being taken up as the shoes wore down.

When we compare this brake arrangement with our present high speed brake, and the perfect control that an engineer now has over the long heavy trains, running at a high rate of speed, we must concede that the greatest improvement made in the last fifty years was the instroduction of the air brake.

The general dimensions of the car follow:

Length out to out of end sills	28 ft.
Width out to out of side sills	8 ft.
Height of studs	6 ft. 3 in.
Height from rail to top car	11 ft. 1 in.
Height from rail to brake wheel	12 ft. 2 in.
Sills	4″x7″
End sills	5″x7″
Plates	3″x6″
Studs	2″x4″
Braces, side and end	2″x4″
Braces, corner	2″x6″
Body Bolster	7″x12″
Truck bolster	5″x12″
Wheels	33″
Journals	3¼″x5½″
Springs, truck and draw.	Rubber

Switching Locomotives, C. & W. I. Ry.

The development of heavy switching locomotives is well exemplified in the ten engines of this type lately built for the Chicago & Western Indiana by the Lima Locomotive Corporation. The designs for these engines were prepared by the locomotive builders according to the specifications submitted by the railway company, and although they represent nothing radical, they do exemplify the modernization of the heavy switching locomotive.

They are of two types: 2-6-0 and 0-6-0. The 2-6-0 type engines are quite similar to those previously furnished to the Chicago & Western Indiana by other builders, but they have been improved along the lines of service experience with the earlier ones. The journals have been made larger than the previous engines and improvements have been made to the side rod and guide yoke to facilitate taking down the front section of these rods. Strictly speaking, the engines are for interchangeable service and not for switching service exclusively. The Chicago & Western Indiana operates a limited suburban schedule, and the Mogul engines are used in passenger service as well as in freight traffic and switching operations. They are equipped with a peculiar design of stub pilot, which has been developed by this railway company, and which embodies the conditions necessary on a pilot for road service and also the conditions necessary for a switching step. These 2-6-0 engines are equipped with brick arch and superheaters and are therefore fully modernized in fuel saving devices. The steam is delivered through outside steam pipes and the piston valves are operated by Baker gear. Merkel main rod ends are used. They are possibly the heaviest Mogul locomotives now in service and represent an ideal engine for short runs in interchangeable service and for operation on sharp curves and various conditions of track.

The tenders of these engines are of special design arranged with the fuel collar set in at the edge of the water leg to allow unobstructed view by the engine man. This arrangement was suggested by the railroad company in accordance with their experience with other tenders of the same capacity which had high coal boards, and which were ill-adapted for the service conditions on this account. The suggested improvement was worked out by Lima Locomotive Corporation and resulted in a handsome tender of rather unique appearance.

The other engines on this order are type 0-6-0 and represent a typical switching locomotive brought up to modern conditions. They are exceedingly heavy, weighing about 164,000 pounds on the drivers, but well balanced, well proportioned and sturdy in appearance. They are equipped with superheaters and brick arch and have outside steam pipes supplying piston valves, driven by Baker valve gear. Markel main rod ends are used. Their fireboxes are of narrow type and the heating surface proportions are proper for modern switching service, although on first analysis they may appear scanty for the weight of the engine. Tenders are 5,000 gallons capacity and are of the ordinary type but built low to allow the engine men to look back over them without obstruction.

The design of these locomotives, as above stated, was to a great extent worked out by the officers of the Chicago & Western Indiana. N. B. Whitsel, general foreman locomotive department, and H. Keller, boiler foreman, are responsible for the mechanical details, and with the co-operation of G. L. Pollak, purchasing agent, the designs were completed. Mr. Keller has since left the railway to enter the employ of the Independent Pneumatic Tool Co., of Chicago.

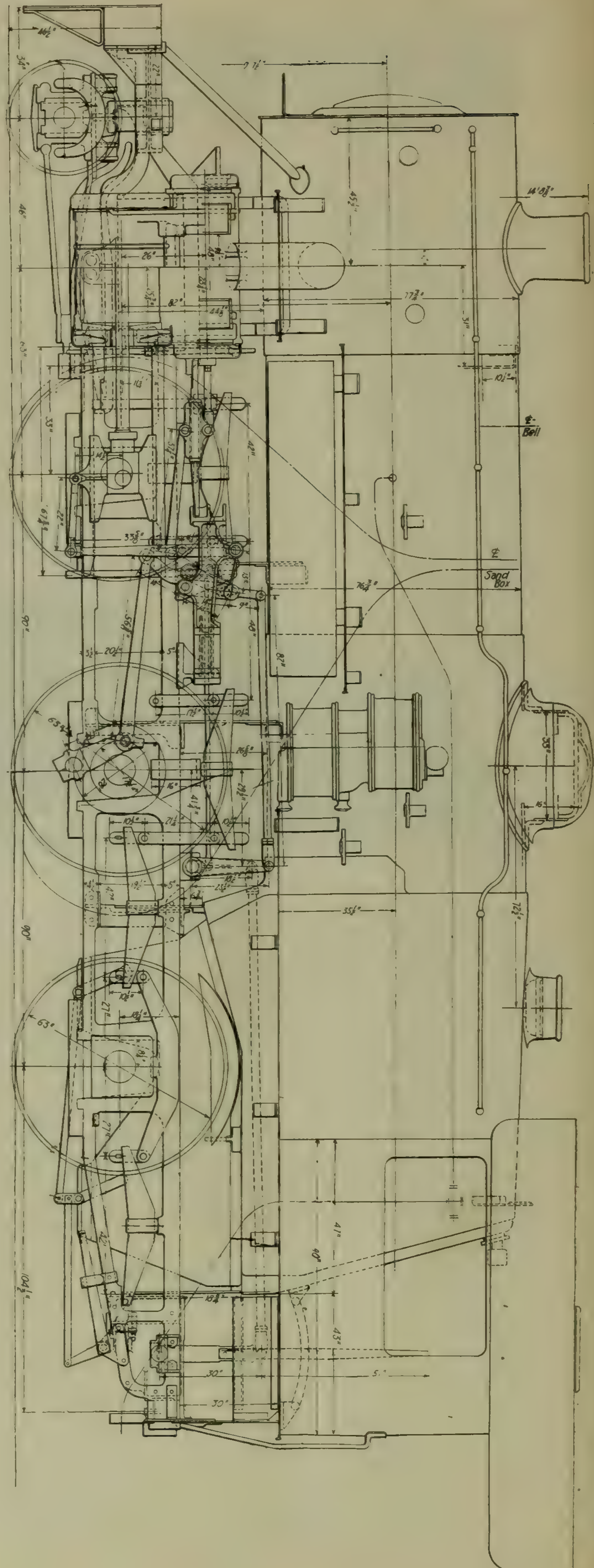
2-6-0 Switching Locomotive, C. & W. I. R. R.

Dimensions and ratios of both types of engines are as follows:

	2-6-0	0-6-0
General.		
Gauge	4′ 8½″	4′ 8½″
Service	Mixed	Switching
Fuel	Bit. coal	Bit. coal
Tractive force	35,900 lbs.	35,700 lbs.
Weight in working order	194,600 lbs.	164,000 lbs.
Weight on drivers	165,200 lbs.	164,000 lbs.
Weight on leading truck	29,400 lbs.	———
Weight on engine and tender, in working order	335,600 lbs.	268,000 lbs.
Wheel base, driving	15′ 0″	11′ 6″
Wheel base, total	24′ 1″	11′ 6″
Wheel base, engine and tender	56′ 10¾″	46′ 7¼″
Cylinders.		
Kind	Simple	Simple
Diameter and stroke	23″ x 28″	22″ x 26″
Valves.		
Kind	Piston	Piston
Diameter	14″	14″
Maximum travel	6½″	6½″
Steam lap	1″	1″
Exhaust clearance	1/16″	———
Lead, constant	¼″	3/16″
Valve motion	Baker	Baker

	Wheels.	
Driving, diameter over tires	63″	51″
Driving, thickness of tires	3½″	3½″
Driving journals, diameter by length	11″ x 13″	11″ x 13″
Engine trk. wheels diameter	33″	———
Engine truck journals, diameter by length	6½″ x 12	———
	Tender.	
Frame	10″ & 13″ channels	10″ channels
Wheels, diameter and material	33″ rolled steel	33″ rolled steel
Journals, diam. and length	5½″ x 10″	5″ x 9″
Water capacity	7,750 gal.	5,000 gal.
Coal capacity	8 tons	8 tons
	Boiler.	
	2-6-0	0-6-0
Style	Straight top	Straight top
Staying	Radial	Radial
Working pressure	180 lbs.	170 lbs.
Outside diam. first ring	76¾″	72″
Firebox, length and width	108″ x 69¼″	108⅛″ x 41″
Firebox, plate thickness	⅜″ x ½″	⅜″ x ½″
Firebox water space	4½″ & 4″	3″-3½″ & 4½″
Tubes, number and outside diameter	201—2″	167—2″
Tubes, material and thickness	Steel No. 11 BWG	Steel No. 11 BWG
Flues, number and outside diameter	32—5⅜″	24—5½″
Flues, material and thickness	Steel No. 9 BWG	Steel No. 9 WG
Length of tubes and flues	13′ 7″	11 ft.
Superheater, type	Schmidt A	Schmidt A
Superheater, number of units	32	24
Hearting surface, firebox	185 sq. ft.	175 sq. ft.
Heating surface, tubes and flues	2,028 sq. ft.	1,325 sq. ft.
Heating surface, total evaporative	2,213 sq. ft.	1,500 sq. ft.
Superheating surface	540 sq. ft.	270 sq. ft.
*Equivalent heating surface	3,023 sq. ft.	1,905 sq. ft.
Grate area	52 sq. ft.	30.7 sq. ft.
	Ratio.	
*Heating surface : grate area	58.1	62
*Heating surface : vol. cylinder	288	166
Weight on drivers : tractive force	4.6	4.6
Total weight : tractive force	5.4	4.6
Tractive force by diameter drivers : heating surface*	750	955
Firebox heating surface, per cent heating surface*	6.1	9.2
Weight on drivers : heating surface*	55	86
Volume both cylinders cu. ft.	13.28	11.44
Grate area : cylinder volume	3.92	2.68

THE DEPARTMENT OF DEVELOPMENT of the Frisco reports that for the six months ending April 1, 2,934 farmers were located along its lines. These farmers brought with them 1,997 cars of farm equipment and purchased 333,765 acres of land, or an area equal to 521 square miles. This development has been carried on without the usual homeseekers' rush or excitement. The present policy of the Frisco is to actually develop its agricultural territory by assisting the communities along its lines in bringing in farmers of a class that are equipped to develop it; men who would be assets to the communities and increase the production of the soil.



Elevation, C. & W. I. Switcher.

STEEL CAR SHOPS AT ANGUS.*

By L. C. Ord.

The Canadian Pacific Railway decided to build at its Angus shops, Montreal, for the construction of steel passenger and freight cars, a plant having a capacity for building ten passenger cars per month and eight freight cars per day. At the time the steel freight car shop was built many thousands of steel frame cars had been built by the contracting shops, both in the United States and in Canada, to the same design as the cars for which the new shops were intended.

As it was anticipated that the greater number of the cars built would be steel frame box cars, the design and lay-out of the freight shop was considered solely with reference to this type of car, in order that the work might be done as cheaply as possible. In designing the shop 2,750 sq. ft. of floor area was allowed per car day, total under cover, as the average for existing shops. To prevent the overcrowding which is common in most steel freight car shops and to allow for the greater amount of room taken up by the design of spacing punches, a larger amount of machine room was provided. The final floor area for the freight shop was made 41,785 sq. ft., the area of the machine shop being 22,069 sq. ft. less 7,265 sq. ft. which was set apart for machining and assembling steel center sills for repair work, giving a total area of 14,795 sq. ft. available for machines. The area of the assembling portion of the freight shop was 9,170 sq. ft., while the erecting area was 17,820 sq. ft.

At Angus a shop already existed for building trucks for both passenger and freight cars, and the trucks are therefore erected, assembled and delivered to the steel shop complete in every respect. There was also a freight shop for building and painting wooden freight cars. In this wood shop, therefore, the steel cars have the floors, lining and roofs applied, except in the case of some all steel roofs. The existing large blacksmith shop made it convenient to arrange that no forging or hot bending work of any sort should be handled in the steel shop, the necessary rivet furnaces being the only ones in the steel shop.

The general lay-out of the Angus plant provides for the convenient location of the wood mill and wooden freight car shop for the finishing and painting of the steel frame box cars, also of the truck shop and of the lorry and overhead crane arrangement for handling the supply of material from the truck and blacksmith shops.

The steel shop proper consists of two 100 ft. bays running parallel with the front of the shop, and at right angles to this one 72 ft. bay 405 ft. long. The passenger shop erecting section is composed of four 27 ft. 6 in. bays 202 ft. 6 in. long, running at right angles to the hundred foot bays and parallel to the freight section.

The crane service comprises a 10 ton travelling crane 96 ft. 3 in. span on a runway 309 ft. long in front of the shop covering the material section and parallel to the cranes in the shop and of the same height and span. Inside the shop there is a 10 ton crane 96 ft. 3 in. in each of the hundred foot bays. These cranes all have a head room of 27 ft.

In the erecting section on the freight side there is a crane of 10 ton capacity, 67 ft. 7 in. span with a head room of 35 ft. 6 in. In the passenger shop four travelling cranes 24 ft. 10 in. span of 2 ton capacity with 20 ft. head room are used. They are for the handling of material for the passenger car work and are operated from the ground. A noticeable feature is that these runways are carried into the main shop about 8 ft. under running the overhead travelling crane to assist in the transfer of material from one crane to another.

The building is steel with brick walls, steel sash being used, and care has been taken to provide a large amount of light, the area of light to the total wall space being approximately thirty per cent.

The floor in the shop is mastic throughout and is an asphalt composition in two ⅝ in. coats, the top being a wearing and the bottom a cushion coat on a concrete base 4 in. thick. After considerable use of this type of floor in various parts of the plant, a floor of rather harder consistency than usual was selected, and although marks will occur if heavy weights are left on it for some time, yet when these weights are removed the marks gradually work out. This floor does not crack or break if anything is dropped on it, as is the case of cement; it is also very much easier for walking or working on, is waterproof and easily kept clean and free from dust.

The crane runway on the midway runs the full length of the plant and far enough in front of the steel car shop to load and unload material from the first two material tracks running through the storage space.

The storage space in front of the shop is arranged so that should it be found advisable to extend the shop in order to afford a cover for the material, to provide for additional machine room or for any other purpose, the crane runway might be transferred to the opposite side of the midway and still be used for the storage of material.

Supply tracks run east and west through the storage space at intervals suited to the arrangement of the machines inside and to the storage of the material outside. Through tracks for the handling of freight cars under load are located at the north of the bay for passenger car material and at the south for material for freight cars. The material is unloaded direct from the cars to the proper piling space, conveniently located with relation to the supply tracks. With this arrangement the material handling is reduced to a minimum and the supply to the shops is for the most part independent of the overhead travelling cranes, which are used principally for unloading cars and handling large quantities of specially heavy material.

In the front portion of the steel shop are two long bays 100 ft. wide. The first bay is 209 ft. 6 in. and the second 182 ft. in length, one bay being longer than the other in order to allow for unloading directly into the shop any material which it was necessary to keep under cover.

The arrangement of the two long bays with travelling cranes running crosswise to the tracks in the shop was particularly suited to the spacing tables and types of machines installed. The crane in the front section was used to supply the material to the machines through which it was carried automatically into the next bay, where the second crane distributed it from the machines to the various points in the shop requiring it.

An effort was made in the lay-out of the shop to use machines with a relatively small capacity, but sufficient in number to prevent the expense and delay of changing dies and setting up, and the big accumulation of material necessary to feed the shop without delay, when one large machine is used for several purposes.

In the freight shop four spacing punches are used. One of these is fitted specially for punching 6 in. Z bars for steel center sills for repairs on the line, and is not concerned in any way with the steel car work. This machine is fed by an independent lorry track. The Z bars require to be punched twice, once for the flanges and once for the webs. The material is run in beyond the punch and is handled through it to the front of the shop. Specially arranged air jacks are used for lifting the Z bars to place on the rollers which feed the machine and also for unloading the punched Z bars from the machine. Skids are so arranged that the Z bars are lifted and skidded off the machine without being touched by hand in any way. It has been found cheaper and quicker to run a quantity of bars through one operation and when a considerable number have been punched to move them back for the second operation, which of course requires a change in the set up of the machine. On the last operation, instead of unloading to the material space at the side of the machine, the Z bars are skidded in the opposite direction onto the rails where they are required for assembling for draft gear, etc. From these skids they are slid onto the trucks, which take them to the front of the shop where the couplers and draft gear are fitted. They are then either loaded direct to cars for shipment on the line or used in the freight car shop where heavy repairs to existing equipment are made. The second spacing punch is used for the side plate of the

* A paper read before the Canadian Society of Civil Engineers.

car a 4 in. Z and floor stringers which are 3 in. Z. The capacity of this machine is well above present requirements.

One spacing table is used for punching the webs of channels (center sills 15 in. and side sills 8 in.), while another machine punches the flanges of these same channels. The machine which punches the webs of the channels does the work in one operation and has, therefore, double the capacity of the flange machine. With the present output of the shop the web punching machine works as above for only one-half of the time, the balance of the time being used on cover plates and similar flat work. An additional punch for the flanges has been installed and the foundations for the spacing table laid out so that without disarranging the handling of the material, by adding a spacing table to the existing punch, it will be possible to double the output of these machines, the spare punch being used for hand work at the present time. With the provision of the spacing table on this coping punch and an extra coping punch, practically no other additions would be necessary to run the machine capacity of the shop up to 25 cars per day.

In the event of a breakdown of any of the punches employed on this spacing table work, serious delay to the output could not possibly be avoided. As additional heavy punches for coping, slotting, etc., were necessary, it was arranged to purchase machines which are duplicates of those used on the spacing tables. If at the present time any one of the punches on the spacing tables should become totally disabled, it would be possible to substitute another punch or part of a punch with short delay and keep the shop running, as in the case of punches for coping and similar work, substitutions could readily be made. On all the machines used in the shops the interchange of punches, gags and other jigs have been closely considered to prevent delay, or the necessity of large stocks being carried.

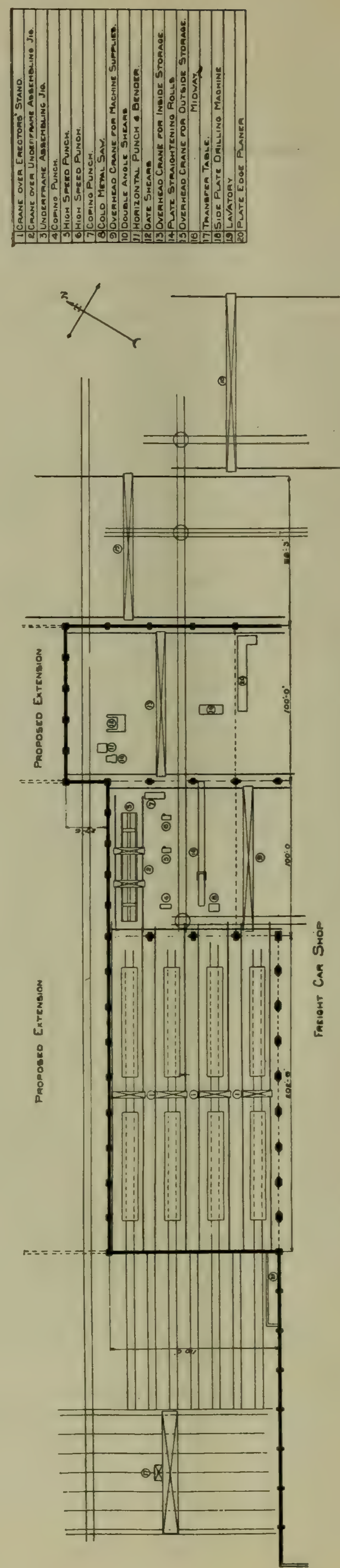
The piling space outside is arranged so that the material can be skidded on to the lorries by hand and taken to the spacing punches and other punches by hand, which in case of trouble with the overhead crane saves a great deal of time. Care was taken in the case of the heavy material, such as the center and side sills, to arrange that each movement should be short and easily handled. The first movement from the pile is to the web punching machine, from which the sills are handled by small cranes and rollers to the flange punching machine without any backward movement. On the flange punching machine the sills are bolted together in pairs, run through the machine, brought back through the machine, turned over and handled through a second time to punch the lower flanges.

The design of the spacing tables is particularly convenient as each of the templates has two lines of gauge points and, therefore, the punching of both pairs of flanges is done on a sill from the same template. From the last movement on the flange punching machine the material is unloaded onto the floor, where a very large space has been reserved to allow of a considerable accumulation of finished center and side sills, to prevent the possibility of delay on these very important items.

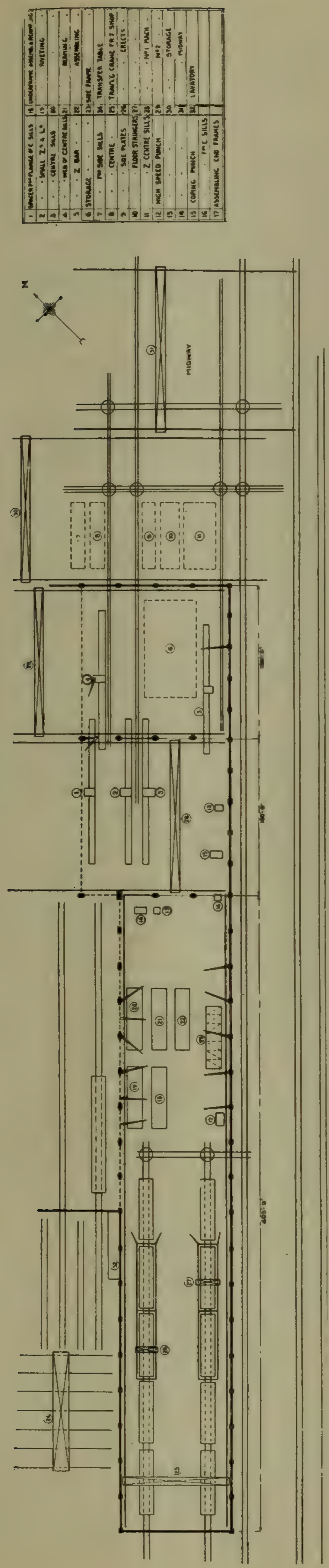
The small track on which the finished Z bar center sills are taken out of the shop is also used to supply the Z bar sections to the small spacing machines. This double lorry track arrangement prevents the crowding which would be inevitable if all the material were handled over one supply track.

The center sills when punched on the webs and flanges also require to have slots punched in them to accommodate the draft gear and brake pipe. These slots are made on a coping punch so arranged as to require no backward movement of the material; this die is left set up on the machine all the time but is so arranged that small dies can be set up beside the large ones to enable the machine to be used for light punching when not punching slots. One other coping punch is fitted up with dies for making the various mitered cuts and coping the side posts and braces. The coping punch beside the Z bar machine is fitted with a special die for coping the side plate.

Three high speed punches are used for all the various small



Angus Steel Shop, Passenger Car Side



Angus Steel Shop, Freight Car Side

punching work around the shop, with the exception of the diaphragms which are punched on a horizontal punch.

This completes the machine equipment for the steel shop, but it must, of course, be borne in mind that the hot forging, upsetting and bending work are done in the blacksmith shop and material is brought into the steel shop already finished.

Special attention has been given to the handling of material to make this, as far as possible, independent of the overhead cranes except for the movement of large quantities of heavy material. For this reason it will be seen that the shop is particularly well equipped with air jacks, skids, overhead fixed hoists, travelling hoists on runways and swinging jib cranes. To reduce the labor and the cost of handling and of repairing, ball bearings and roller bearings are used throughout on jibs, hoists, hand travelling cranes and material rollers. Special care has been taken to have definite room allowed for the piling of material outside the shop, for the storage of material around the various machines and the storage and accommodation of the finished material. Specially constructed racks are used throughout the shop. To maintain the orderly handling of the material, painted lines are used to define the boundaries of these piles and mark the passage ways, which are always kept clean of material. These boundary lines are repainted at the end of every week, at which time an absolute clean-up is made of any material which would otherwise tend to accumulate.

The Thomas spacing tables are of the semi-automatic type. The movement of the carriage is controlled automatically, while that of the gags for bringing one or more punches into play at each stroke is controlled by hand. The tables are electrically operated, their movement being controlled by two templates ⅞ in. by 3 in. having a double row of steel pins. They are so arranged that when the trip on the moving portion of the table engages the pin it automatically stops and locks the material to be punched and at the same time, by means of an electric magnet, operates the clutch on the punch. The punch head, after coming down and punching the material, on its return stroke disengages the carriage and the clutch on the punch and automatically starts the movement of the material. The operation is repeated as each successive pin is encountered. The particular value of this type of machine is that templates may be made up of wooden strips with pins driven in at very short notice and small cost, while permanent steel strips with inserted pins can be made up for permanent work. The strips can be changed in a few moments and are kept at hand for the various classes of material to be handled. The accuracy of the work practically depends upon the accuracy of the template, and the results obtained are extremely satisfactory.

The high speed punches were designed specially for this shop by John Bertram & Sons. They run at the high speed of 60 strokes per minute and are entirely without gears, being belted from the motor direct to the flywheel of the punch. The clutch is of the six point type; two punches are fitted in each head, both being controlled by a single gag lever which has three positions, one for each punch and a neutral position.

These high speed punches are not equipped with spacing tables, as it was found that on account of the slower movement of the carriage on the spacing table and the consequent time lost in entering the piece, hand punching for small, light pieces was cheaper, providing the same could be made sufficiently accurate. To do the punching more accurately the method adopted was that of using a drilled or punched template and of butting the piece against a gauge inserted in each successive hole in the template. The usual method is to make up a square template at one side of the machine, having one or more rows of holes punched in it on each of the four sides, some having as many as eight different rows of holes, each row being used as a template. The material is moved along the top of the gauge until it butts against a pin inserted in each hole in turn. It is found that for certain classes of work the gag is thrown in on the punch and the operator can move the material fast enough to catch every hole with the punch running at 60 strokes a minute. This is nearly three times as fast as the rate at which it would be punched on a spac-

ing punch, and the time of setting up and the backward movement of the carriage is saved. While only one piece is handled at a time the cost of punching light, short material per hole is fully as cheap as when done on the spacing punches. On some of the punches where there is little variation in the work handled, single sided templates are used with 3 or 4 rows of holes, which take care of the work satisfactorily. No marked off work of any kind is used in the shop, except for irregular pieces which cannot be punched in the spacing punches or by the method described here, and most of the other work is punched to a gauge where it is possible to design one. This not only reduces the time in punching and saves the expense of marking off, but greatly increases the accuracy of the work done.

ASSEMBLING.

Special arrangements were made for the storing and handling of material in relation to the assembling to reduce the labor to a minimum. With underframes an important gain was made by the use of clamps instead of assembling bolts, the common practice elsewhere. For an assembling bolt, it is necessary to get a full hole before the bolt can be applied; a wrench is required and the time spent in this way is greatly reduced by using a clamp with a hinged handle. The clamp is applied between the holes to be reamed, and the time lost in removing the bolt from one hole and applying it in the adjacent hole when reaming is entirely avoided. The clamps are applied by the men assembling. They are not touched by the men reaming but are removed by the riveters as they work up to the clamps. They are collected from the floor by a laborer and carried back to the assembling position for the next succeeding frame.

In assembling the underframe a jig is used which accurately locates the center sills, bolsters and cross bearers. By this method the sills are assembled square, reamed in the same position and then transferred to the underframe riveting jig. This jig consists of a number of cast columns supported on I beams bolted on a concrete foundation and securely holds the underframe in position while being riveted, so that the underframe is constructed accurately and square in every way. A great deal of time is thus saved in the assembling and the line of the car when finished is very greatly improved. To rivet the underframe on the jig by compression riveters without turning it over, it was necessary to have a special type of riveter designed with a thin nose to permit the top row of rivets to be driven and to allow sufficient clearance for the bottom row, particularly on the bolsters, to be driven without moving the underframe. The makers considered that this would be an expensive type of riveter to maintain, but quite the reverse is the case, for though a heavy block of cast steel is used for the top die a small high speed steel insert is used. It is not possible to use a high speed steel snap for ordinary work, as it is extremely liable to break, but when it is inserted in the cast steel block it is well supported and does not fracture. It is much denser than any other material that could be used. When renewed the amount of steel is so small that the cost is not considerable, and it has easily proved to be the cheapest type of die for maintenance of any compression riveter in the shops.

The movement of the steel sills from the point of assembling to the jig where they are riveted together is to be handled entirely by small air jacks running on trucks on narrow gauge rails which move the underframe from position to position without requiring the use of the overhead crane. This, of course, saves a considerable amount of time and enables the movements to occur simultaneously, which could not possibly be done if it were necessary for the crane to move the mall, as the crane can only handle one at a time. The value of this time saved is considerable and easily appreciated. The only portion of this output which is fixed is that of riveting the underframe with the compression riveters, and the capacity is about fourteen or fifteen cars per day. Provision is, therefore, made for the installation of an additional position for riveting the underframe along the side wall of the building where the jib cranes for handling compression riveters can easily be located. The other positions can easily handle twenty-five cars a day, by the addition of more help where required.

For assembling the side frame a jig was designed by which a considerable improvement has been attained over former practice. The side frames for as many cars as are required are built on one jig, all the parts being placed in templates, giving them a fixed location. The riveting on the lower side sill is handled by two suspended compression riveters, the balance of the riveting being done by hand. The parts are at present clamped together by hand clamps, which will shortly be replaced by fixed pneumatic clamps in order to hold them more rigidly and avoid the time lost in applying and removing the hand clamps. Special attention has been paid to the loss of time in locating and applying clamps, and pockets are arranged in the frame so that everything is as close as possible to the point where it is to be used. Even more care is taken in the racks for the material, as each post and brace is piled directly opposite to where it will be used in the frame. A small gantry crane is being constructed to handle this material from the jig to the piling space, so that no time whatever will be lost waiting for the travelling crane.

The same arrangement is made for the end frames as for the side frames, a small travelling crane being used to handle the finished end frames from the assembling sections to the place where they are piled.

ERECTING.

The erecting is commenced at a point where the trucks are brought in from the supply tracks at the side of the shop and handled across turntables into proper position. The underframe is then brought down by the travelling crane and placed on the trucks. In the first position the floor stringers are riveted in place and one end frame is lifted on by a jib crane specially constructed for that purpose. When this is done the underframe is moved down to the second position, and the side frames are lifted up by two special hoists from the convenient piles where they have been placed by the overhead crane, and the other end frame is lifted to place by a jib crane. In the third position the carlines and the riveting up on top of the car are completed on an overhead scaffolding which allows the men to work conveniently. There is also an upper floor and special racks for the accommodation of the carlines and other material.

An all metal roof designed by the Canadian Pacific for these cars required special handling. The usual practice was to allow the cars to go out of the shop with the carlines riveted in place, and the roof sheets and various wooden parts of the roof were applied in the wood freight car shop. This roof being all steel with outside carlines, it was necessary to apply the roof sheets before the carlines, and therefore the roof was assembled and erected complete on the cars in the steel car shop in two positions and the cars turned out of the steel shop with the roofs complete in every respect except for the application of the wooden running boards. This is a very unusual feature and the fact that the entire output of the steel shop could be handled in this way is evidence of how readily the roof and carlines are applied. The cuts show the arrangement of upper scaffold platforms which were used for the application of the carlines of the ordinary roofs and for the convenient storage of carlines and roof sheets for the all steel radial roof.

Room for a fifth erecting position is allowed but this is not required with the present output of the shop. The cars are moved outside by a motor driver car pull situated in the lower end of the shop, are sent over to the wood shop for lining, roofing and painting, and are then reported for service.

STEEL PASSENGER CAR SHOP.

The method of handling material in the passenger shop is the same as for the steel freight shop. The arrangement of the machines is similar, except that it is not possible to get enough work of the same class with the relatively small output to use spacing tables to advantage. A coping punch is, therefore, fitted up with rollers for the convenient handling of long material, and the work is punched to gauge much in the same way as on the smaller punches, although considerable marked off work has been used up to the present.

The operation of the high speed and other coping punches is also similar to those used in the freight shop. The additional machines comprise plate straightening rolls for straightening or bending plates; and a plate edge planer for the outside sheets for the coaches. A cold saw and metal band saw are used for cutting accurately such material as would not be handled to advantage in the shears. A large gate shear, double angle shear, combination horizontal punch and bending or straightening machine complete the ordinary machine equipment in the passenger shop.

As it has been decided to drill the side plates instead of punching, a special drilling machine was installed for this work. This is of similar construction to a locomotive frame slotting machine, the plates being laid out on a long table and a travelling head provided fitted with a number of electric drills. The head, of course, is very light in order to make it easy to handle. Templates with hardened steel bushes for drilling are used as in ordinary good practice. By laying several sheets one on top of another and drilling a number of holes at the same time, the drilling costs are reduced to a minimum and compare very closely with the cost of punching in an automatic machine besides being necessarily much more accurate, and the drilling does not buckle or distort the sheets or leave a rag on the lower edge as in punching. This is very important for the side sheets on the car where the rivets are small and small errors in the location of the rivet holes are relatively serious. It is intended to handle the drilling of the long side members of the car in the same way as that of the side sheets.

The drilling of the small side cover plates will also be handled on a jig on a small sensitive drill and it is intended to use rollers and stops in order to minimize the cost as far as possible.

ASSEMBLING.

The same arrangement of an assembling jig is used in the passenger shop as was adopted in the freight, but the number of operations was reduced to one, and the assembling, reaming and riveting of the underframe is done in one position. On account of the much greater length of the jig and the fact that the wall of the shop adjacent is considered as a temporary wall, in view of the probable extension of the shop, it was impossible to use a jib crane of any type because of the head room that it would require. A low crane runway was, therefore, adopted, with small travelling cranes to carry the riveters. With this arrangement the number of riveters needed can be increased indefinitely in proportion to the output of underframes required, which certainly could not be done in the case of jib cranes; it further enables the underframe to be lifted out in either direction. The underframe jig is located centrally in the shop in view of the probable future extension.

ERECTING.

The noticeable feature of the erecting portion of the passenger shop is the arrangement of small bays running lengthwise over each track, small travelling cranes just large enough to handle material or riveters as required, and an unique arrangement of scaffold posts short on one side so that the cranes can operate over them, but still enough to carry rivet furnaces for the roof work, men's tools, etc., or to serve for a backing for light drilling work on the side sheets or framing. Where the posts of the shop run these are made to do double duty, to provide for the adjustable scaffolds so necessary in erection work of this sort.

Special rivet furnaces are used for the heating of rivets to prevent the pitting so common in the ordinary oil furnaces. These muffle furnaces have given very good satisfaction, and while they are slow in heating up, burning of rivets and pitting is very materially reduced. In the passenger sections there are two positions on each track and four tracks. The output in the original layout of the shop was based on a ten car output per month; it was thought that each car would stand ten days in each position and that the underframe would turn out a car for every two and one-half working days, but it is evident from the progress already made that a better output than this will readily be obtained. In the first position the posts, end frame and complete frame work of the car are erected and side roof sheets and hood sheets are applied. As the car leaves the first position it is run on by the second position outside the shop where it is sand blasted and then returned to the second position for finishing. In the second position the center roof sheets and flooring, including vestibule trimmings, etc., are applied. The car is then sent over to the wood passenger shop for inside trimming and finishing. A transfer table is provided at the outside of the shop for switching the cars from track to track or to the outgoing track, and the sand blasting at the present time is done outside the shop between the shop and the transfer table.

In the erecting portion of the shop the cuts show more of the interesting methods that are used in the erection, the use of clamps and the adjustable scaffolding. Special attention to the convenience of the men is shown in the temporary side deck platforms for working on the center deck, the scaffold posts which serve as ladders, the convenient rivet supply and location of air hose connections.

ADAPTABILITY OF THE ELECTRIC LOCOMOTIVE TO SWITCHING SERVICE.

Approximately eight million people are served by the New York, New Haven & Hartford in rendering service to the New England States. Of all freight hauled in and out of New England by rail, this road handles 75 percent of it. The majority of this freight is carried via the Harlem River division and the Harlem River and Westchester freight and transfer yards.

Although the complete electrification of the New Haven road between New York and New Haven has not yet been placed in electrical operation, the switching of all freight cars between Stamford and Harlem River has been done successfully by electricity for approximately 18 months. The economies obtained by the use of the electric switcher locomotives have exceeded all the expectations of those who are responsible for their application to this field.

The reliability of this switcher locomotive equipment has proven to be far superior to the steam locomotive in switching service and the operation of these electric switcher locomotives is a source of satisfaction to the operating department and trainmen who have this work in charge.

The three main switching yards on the New Haven system are:

Harlem River yard, length	23.3 miles
Oak Point yard, length	37.16 "
Westchester yard, length	22.29 "

Also the Van Nest yards, which are used for storage only.

In March, 1911, the first switching engine was placed in operation at Stamford, Conn. In August, 1912, the first switcher started to work in the Westchester yards; in September, 1912, the first in the Oak Point yards in float service and in August, 1913, the first began its operation in the Harlem River yards proper.

The service performed by these locomotives in the Oak Point yard is of special interest. This yard is the terminal where all the cars or flats destined to the New England states are unloaded. Each float is properly docked and secured. There are two large controlling bridges at this terminal, one having accommodations for five floats, and the other for three. These bridges contain all of the counter weights used to compensate for the weight of the individual gang or approach bridges, besides all control apparatus necessary for the proper operation of these float docks.

The entire gang bridge to each float is hinged on to the mainland. The bridge consists of two parts connected by a hinged joint. Each of these two parts of the approach bridge leading to a float is raised and lowered electrically as the case may be by means of two controllers. In addition to these controllers, there are two controllers which manipulate two motors connected to a friction drum which by means of a rope holds the floats in their slips securely to the gang or approach bridge.

Switcher Installation at Oak Park Yard, N. Y., N. H. & H. R. R.

Three large steel bars are used to keep the tracks on the float properly aligned with tracks on the approaches while cars are being loaded or unloaded.

It requires six movements to unload a float and dispatch a train to the yard; also six movements are necessary to load a float. When either loading or unloading floats, there are always two flat cars coupled between the electric switcher locomotive and the cars being hauled on or off the float. In this way the locomotive always remains on land and is never supported by the approach and the two flat cars act as an arm for reaching the train.

Each float has three tracks, two with a capacity for eight cars and a center one for six cars. In this float service it is important to load and unload cars so that the floats do not capsize. This is prevented as follows: the eight cars on track No. 1 are hauled off until two cars remain, enough to have about 100 tons on this track, and this train left standing until later. Then all the eight cars on track No. 3 are hauled off. Next the six cars on track No. 3 and then off. Finally the eight-car train which was partially removed is hauled off. The minimum time required to load and unload a float (12 movements) is thirty-five minutes.

To date not a single feature has developed in which the electric locomotive is not superior to steam locomotive in switching service. The ease with which electric locomotives are controlled, the elimination of stand-by losses and those that are necessary where coal and water are used, elimination of liability for freezing up in cold weather, are all features which are to be credited to the electric locomotive.

Six single-phase electric locomotives do the work of approximately twice the number of steam locomotives formerly used. A total of eight of these electric locomotives are sufficient for practically all of the switching work between Stamford and Harlem River station. These are kept in service 24 hours a day, each making on the average of approximately 140 miles in 24 hours with three eight-hour crew shifts. The electric locomotives handling the work between Westchester yard and Harlem River for a given month made 38,000 locomotive miles and consumed approximately 896,000 kilowatt-hours of electrical energy at the locomotive.

During this same period, the six locomotives handled approximately 65,000 cars which had a total weight of approximately one million tons. Practically all of these cars were transferred from floats and since the control of the electric locomotive is more sensitive than the control of the steam locomotive, this is a feature that appeals strongly to the operators.

All of the heavy freight tonnage mentioned above is handled within the corporate limits of New York City, and the elimination of smoke by the use of the electric locomotive is another advantage which has appealed to all parties.

There are sixteen switching locomotives included in this installation. Each locomotive is equipped with four Westinghouse No. 410, 125-h. p., 25-cycle, single-phase motors and unit switch control. These locomotives each weigh 80 tons and are able to exert a maximum tractive effort of 40,000 lbs. with a clean dry rail.

The following figures give the rated hauling capacity. On the average road, the load that can be handled is determined by the maximum grade.

Track Profile.	Number of Cars, Each Weighing 45 Tons with Load.	Max. Speed M. P. H.
Straight Level Track	67	8.5
½% Grade	28	8.1
1 % Grade	17	8.1
2 % Grade	9	8.1

The figures given for "straight level track" show the load which may be handled in infrequent switching service.

The switching locomotives areg uaranteed to exert a maximum tractive effort of 36,000 lbs. for about three minutes at speeds up to 6 m. p. h. and a continuous tractive effort of 14,800 lbs. at a speed of 11½ m. p. h. In practice it has been found that an electric switching locomotive can do the work of two steam locomotives because it can be operated both day and night. In fact, the first switching locomotive furnished has been in use for about 20 hours a day in the yards at Stamford. It is not expected that the maximum voltage on the motors will be reached in ordinary switching service, but it is available when climbing grades or on longer runs in the yard. The average operating potential is estimated to be 190 volts. The hour rating corresponding to this voltage and current of 900 amps. is approximately 125 h. p. per motor.

Arrangements have been made for a large bridge, known as the interconnecting railroad bridge, between Harlem River and Long Island City, which will physically connect the Pennsylvania and New Haven systems. Electricity as a motive power will be used entirely for handling all traffic over this bridge.

May Meetings

AIR BRAKE ASSOCIATION.

The twenty-first annual convention of the Air Brake Association was held at the Hotel Pontchartrain, Detroit, Mich., on May 5 to 8. The sessions were presided over by the president W. J. Hatch. In the president's address Mr. Hatch paid tribute to the late George Westinghouse. He also urged some sort of an arrangement for adjusting the slack on freight cars. The convention was also favored with a short talk by H. H. Vaughn, assistant to the vice president of the Canadian Pacific. He expressed great confidence in the future of the electrically controlled brake. W. A. Garrett of the Pere Marquette, addressed the members on some of the problems of railway officials.

The caboose air gage and conductors' valve was the subject of a paper by Mark Purcell of the Northern Pacific. Mr. Purcell stated that in his opinion the best practical device for this purpose is a valve that can be opened quickly, and will provide a sufficient opening to insure quick action of the brakes the entire length of the train, or can be opened gradually, and a small amount, to produce a slow reduction to cause a service application, in cases of an immediate stop being necessary, and yet sufficient time available to permit of exercising care to avoid quick action of the brakes, which might, and often does, cause serious damage to the train, particularly when the quick action starts from the rear. When it is found necessary to open the conductor's valve to apply brakes on a freight train, it should be left open until the train stops.

George W. Noland of the P. C. C. & St. L. read a paper on "Modern Train Handling." He said that every fair-minded person who has any knowledge of train building will agree that the 40,000, 50,000 and the older 60,000 capacity equipment has no right to be placed on or near the head end of the long heavy through trains. Most break-in-twos occur in that particular class of equipment, as the draft gear is not heavy enough to withstand the shocks and surges that are sometimes evident. No car which is known to have its brake cut out should be placed in any train. The car should be sent to the repair track and have the proper repairs made, even though delayed for another schedule. There are cases enough where they are cut out while a train is in transit from one terminal to another.

A paper on the "Electro-Pneumatic Signal System" was presented by L. N. Armstrong of the Pennsylvania. Mr. Armstrong said in part:

The electro-pneumatic signal was developed a few years ago to meet the needs of roads that were using multiple unit electric cars to handle suburban service. The signal switch to which the ordinary bell cord is attached has two wire connections, one for supplying the current to the switch, and the other for conveying the current from the switch to the magnetic valve in the cab. When the cord is pulled, contact is made between the two wires, resulting in current flowing to the magnet valve, causing the signal whistle to immediately sound. When the cord is released, the spring on the side of the signal switch forces the contacts of the switch apart, breaking the circuit and thus stopping the flow of current, causing the air valve in the magnet valve to be seated. The magnet valve consists of an electro-magnet, which, when energized, unseats a small air valve, allowing main reservoir pressure to flow directly to the whistle. The whistle will continue to sound as long as current is passing through the circuit. When the flow of current is cut off from the magnet valve, a small spring assists in seating the air valve.

The whistle has an adjustable bowl, and is the same as that used with the pneumatically operated signal. When using high main reservoir pressure, it has been found advisable to insert a choke in the pipe connection leading to the whistle having a 3-64 inch opening to prevent the whistle from screeching. The whistle can be attached to the bottom outlet of the magnetic valve by a short elbow and nipple, and when directly connected in this manner quick transmission of any number of blasts is possible, as the air has a very short distance to flow.

A combined car discharge valve and train signal switch is designed to cover the transition period on steam trains. It is the ordinary car discharge valve, having a set of contacts added and arranged so that when the cord is pulled the car discharge valve is opened and, at the same time, contact is made. A test train, consisting of an engine and twelve steel cars, was operated for a period of four months on the Pennsylvania Railroad, with such satisfactory results that the electro-pneumatic signal was recommended to be applied to all new equipment. This will eventually result in removing the train signal pipe and hose from the equipment, which will no doubt cause a considerable decrease in the expense of maintenance, and at the same time result in fewer detentions from signal failures, as well as quickening the operation of suburban trains which use the train signals for starting. With this signal system, it would be possible to have a code in which long and short blasts were used, and thus increase the communication between train and locomotive without using a large number of blasts. A test was made in which the signal cord was pulled 17 times in a period of five seconds, and all of the signals were correctly transmitted. It is absolutely free from false signals, and economical to maintain. The operation of this signal on 90 cars during the past six years has shown its reliability and low cost of maintenance, requiring no periodical inspections.

An informal talk on the foundation brake gear was given by T. L. Burton of the Westinghouse Co. He said that this gear has been a success, but that it must be carefully applied.

A short paper on air brake hose was given by T. W. Dow of the Erie. He said that the new M. C. B. specifications would eliminate a great deal of trouble, and also laid emphasis on the matter of incorrectly proportionate gaskets.

Fred von Bergen of the N. C. & St. L. gave a brief paper on air brake efficiency in which he claimed that brakes could not be maintained at 100% efficiency. This subject received quite a thorough discussion.

ASSOCIATION BUSINESS.

The following new officers were elected: President, L. H. Albers, New York Central Lines; first vice-president, J. T. Slattery, Denver & Rio Grande; second vice president, T. W. Dow, Erie; third vice-president, C. H. Weaver, Lake Shore & Michigan Southern; secretary, F. M. Nellis, Westinghouse Air Brake Company; treasurer, Otto Best, Nathan Manufacturing Company. The new members elected to the executive committee were: L. P. Streeter, Illinois Central, and Mark Purcell, Northern Pacific.

The secretary reported that the association had about 1,200 members and a balance on hand of $1,324.58. About 300 members were in attendance at the convention.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.

The sixth annual convention of the International Railway Fuel Association was held at the Hotel La Salle, Chicago, on May 18 to 21. The convention was opened by the address of the president, Robert Collett, who touched on a number of the problems with regard to fuel and urged greater co-operation between all departments. Dr. W. F. M. Goss gave an interesting talk on coal values and coal production. He also spoke of the great progress the railways in Chicago have made in eliminating smoke.

The papers presented, together with brief abstracts of each are as follows. S. W. Parr, professor of applied chemistry,

University of Illinois, gave a paper on "Honeycomb and Clinker Formation." His conclusions were: First, the chemical condition, which seems to be most conducive to formation of honeycomb, is the one in which the percentage of iron pyrites is high.

Second, any conditions in the combustion chamber which by reason of the time interval for complete oxidation, or temperature stages, or deficiency in oxygen, which would promote the formation for any brief length of time of the iron pyrites in the ferrous sulphide stage, is a condition likely to promote clinkering.

Third, the physical condition most active in promoting the formation of clinkering of particles in the fire box above the grates is found in the finely divided material, which is both high in ash and high in iron pyrites.

Fourth, at least one practical suggestion is indicated, namely, that so far as is possible the fine stuff be eliminated from the material as fired. Material of this sort may be much more readily handled in fires which are not conducted under such forced conditions as to draft and speed of combustion, it being only necessary to give ample access of oxygen until the time of complete burning out of the sulphur, after which the tendency to fuse is reduced to the minimum.

M. C. H. Hatch, superintendent of fuel service, D. L. & W. R. R., presented a paper on "Relation of Front-end Design and Air Openings of Grates and Ash-pans to Fuel Consumption and Sparks," saying in conclusion:

Let us design the front-end so that it shall be as efficient a vacuum pump as possible; let us get the boiler tube ratios right; let us admit plenty of air, well distributed, through the grates, and let us open up the ash-pans so that the front-end pump does not have to work against added restrictions there. If we follow these practices, we shall make progress. Fuel economy, from the standpoint of design, means the use of a boiler and furnace which will take out the greatest possible amount of heat (perfect combustion) from the coal, at the expenditure of the least possible amount of energy. If an engine has a front end with restricted gas areas, inadequate netting surface, poorly designed draft pipe, and has an improper tube arrangement, insufficient air openings through the grate and less through the pan, the result is obvious. To burn coal we must have air; to get the air we must have draft, and to get the draft, under the adverse conditions outlined, we will "nozzle her down." How will its performance then compare with another which is arranged according to the rules indicated in the first part of this paragraph?

Finally, I want to say that all my investigations show that the amount of definite and authoritative information on the subjects under consideration is amazingly small. We *should* and *must know* more about these matters and this association should undertake the work of investigation, and at once. I therefore suggest that we, as an association, bespeak the aid of the Pennsylvania R. R., Purdue University and the University of Illinois, requesting them to collaborate with a committee, to be appointed by this association, with a view to determining and finally enunciating what, for modern practice, should most efficiently govern the design of the details we have just considered. This committee, with the president of this association as chairman ex-officio, to submit a report with recommendations covering the net results of the investigations, at the next convention. These matters are of the highest importance in modern locomotive design, and if we can accomplish their determination we will be well repaid for our labor in the good which will accrue to the railroads of this country as a whole and to ourselves as an association.

A paper on "Uniform Methods of Computing Fuel Consumption" by C. F. Ludington, chief fuel supervisor of the Santa Fe, advocated a daily accounting system giving as its principal advantages: increased supervisions over trip performances resulting in interesting the individual in economical use of fuel; better power condition by being able to stop the steam leaks causing excessive consumption of fuel in five or six days instead of as many weeks; reduction of engine failures; better train loading; better train despatching, enabling trains to get over the road with minimum delay (this means reduction in overtime paid enginemen and trainmen and improved working conditions); reduction of terminal delays, both as to engines and trains. C. G. Hall, fuel agent of the Chicago & Eastern Illinois, had a carefully written and comprehensive paper on the storage of coal, its feasibility and advantages to producer, carrier and consumer. In conclusion he stated that the storage of bituminous coal can only be made feasible by the producer, carrier and consumer co-operating closely to carry on the work in a systematic and economical manner.

"Sizing of Coal for Locomotive Use" was the subject of a paper by A. G. Kinyon, locomotive fuel engineer of the Clinchfield Fuel Co.

It is Mr. Kinyon's opinion that where coal is machine mined and shot only with powder, the best and cheapest method of sizing for all concerned, will be to pass such coal over a 5 or 6 inch screen. The amount of fine slack coal so mined is negligible and the lumps that pass over the screen can be disposed of for other purposes and at a higher price which will allow a lower price for locomotive fuel.

A committee paper on modern locomotive coaling stations gave conclusions and some data on this subject. The discussion of the paper went into the feasibility of scales for stations quite thoroughly. The committee on firing practice made a number of changes in its recommendations of last year, which were accepted.

A paper on coal space and adjuncts of locomotive tenders was presented by L. R. Pyle, traveling fireman, M., St. P. & S. S. M. Ry., who gave some very valuable suggestions on the subject.

Monro B. Lanier, of the Norton Coal Mining Co., read a paper on preheating locomotive boiler feed water, which touched on the salient facts and gave the facts and figures on the subject in a connected chain of thought. The concluding paper of the sessions was by F. W. Foltz, fuel supervisor of the Missouri Pacific on the subject of economies in roundhouse and terminal fuel consumption. The paper covered cleaning fires, cleaning flues, care of grates, care of boilers at terminals and waste of fuel in building fires.

President Mohler of the Union Pacific made a few remarks at one of the meetings, as did H. L. Cole, assistant secretary of the government railway board of India.

ASSOCIATION BUSINESS.

New officers were elected as follows: President, D. R. MacBain, L. S. & M. S. Ry.; vice-presidents, D. C. Buell, U. P. R. R., J. G. Crawford, C. B. & Q. R. R., and B. P. Phillippe, Pennsylvania R. R.; secretary-treasurer, C. G. Hall, C. & E. I. R. R., 922 McCormick Bldg., Chicago. The secretary's report showed a membership of 642 and a balance of $885.25. The registration at the convention was about 325.

It was decided to hold the next convention in Chicago on May 17 to 20, 1915.

MASTER BOILER MAKERS' ASSOCIATION.

The eighth annual convention of the Master Boiler Makers' Association was held at the Hotel Walton, Philadelphia, on May 25 to 28. The members were favored by addresses by Rudolph Blankenburg, mayor of Philadelphia; S. M. Vauclain, vice president of the Baldwin Locomotive Works, and Ivy L. Lee, executive assistant to the president of the Pennsylvania.

The committee on "The Advantages and Disadvantages of Oxy-Acetylene and Electric Welding Processes for Use in Boiler Maintenance" reported in part as follows:

Cracks in firebox sheets of all kinds have been welded with the acetylene process and some very good results have been obtained. One report shows that cracks 15 and 20 inches long have been welded with acetylene and have given eighteen months service without trouble; also half side sheets have been successfully welded. Much trouble has resulted, however, from sheets cracking adjacent to the welds, or in the welds themselves, due to the unequal stresses placed upon the sheet when cooling.

Acetylene is found to be serviceable in heating sheets for laying up, in the fitting of boiler work; also in straightening crown sheets where same have been damaged by low water, as the heat

can be localized and thus not injure adjacent sheets. It has been found dangerous to make welds adjacent to riveted seams and stay-bolts as both are prone to leak after such treatment when the boiler again is placed in service.

Electric welding, as with its predecessor, is past the experimental stage and its value is unlimited. One very important thing in connection with electric welding is that it is not dangerous to the operator, or those coming in contact with it, as there is nothing explosive about it, and the voltage is low.

Electricity has been used to some extent for cutting, but its greatest value is in welding. Cutting is done with a carbon, using it in the holder the same as the iron rod is used for welding. This method of cutting is not a fast one, but it can be used where it is difficult to get with a pneumatic hammer.

Side sheets, half side sheets and patches, firebox sheets, are found to be very successfully applied, using the welder in making the seams joint the sheets the same as in a butt joint. Experience has shown that the more crooked the seam the more efficient the welding is, that is to say the sheet should be cut in an irregular outline so that the weld will not be in a straight line. In regard to patches, the same holds true, the more irregular the patch the better the weld.

The committee on "Benefits Derived from Treating Feed Water for Locomotive Boilers Chemically" summed up the benefits derived from treating water with soda ash and lime in treating plants or putting soda ash direct into locomotive tank where blow off cocks are used, as follows:

1. Failures from foaming are practically unknown.
2. Washout period is extended.
3. Changing of water not necessary.
4. Better circulation, making better steaming engines.
5. Boilers are kept clean, burnt and buckled side sheets are very rare.
6. Leaky flues and side sheets are avoided. (This is a big item.)
7. Engines are run longer between shopping for flues because scale is softened and removed by blow off cock in form of mud.
8. Decrease in expense of upkeep in roundhouses.
9. Better feeling among men running engines, because engines are not failing on the road due to leaking and foaming.

It would not be fair in saying that all the benefits mentioned above can be derived, unless the boiler work in the roundhouse is done properly. Flues must be expanded when needed and when locomotive is washed, all plugs must be removed and the boiler washed until thoroughly clean of mud and scale, which can only be determined by inspection of a competent foreman or boiler maker before the plugs are replaced in boiler.

The committee on "The Advantage or Disadvantage of Combustion Chambers in Large Mallet or Pacific Type Engines, Other Than a Shorter Flue," found that but few railroad companies are using boilers with a combustion chamber to any great extent.

The experience of the Chicago, Milwaukee & St. Paul is given which has at the present time about 605 engines equipped with combustion chambers consisting of Mallet type, Mikado type, Pacific type and Prairie type, all being equipped with arch tubes and arch brick.

The committee on Combustion and Fuel Economy took up quite thoroughly the chemistry of combustion and some of the factors that effect it. Reports were also presented on "Uniform rules regarding the load on stay bolts and boiler braces." "Most efficient shape and size of head of radial stay bolt in crown sheet of oil-burning engines." "Does flue cleaning or rattling have any effect on scaling of flues," and "proper disinfection of a boiler while in service."

ASSOCIATION BUSINESS.

The following new officers were elected: President, Jas. T. Johnston, A. T. & S. F.; vice-presidents, Andrew Greene, C. C. C. & St. L., D. A. Lucas, C. B. & Q., John B. Tate, Penn. R. R.; secretary, Harry D. Vought, 95 Liberty St., New York, N. Y.; treasurer, Frank Gray, C. & A., Bloomington, Ill. The secretary's report showed a total of 543 members with 417 in good standing. The treasury showed a balance of $647.67.

RAILWAY STOREKEEPERS' ASSOCIATION.

The eleventh annual convention of the Railway Storekeepers' Association was held at the Hotel Raleigh, Washington, D. C., on May 18, 19 and 20 and was presided over by the president, J. W. Gerber. Mr. Gerber, in his opening address, commented on the work and growth of the association. The association was favored with an address on the ideal storehouse system, by Fairfax Harrison, president of the Southern Railway. He urged the cooperation of all departments and the elimination of obsolete stocks.

The accounting committee presented a detailed report with regard to rules governing the accounting for material and supplies at storehouses. The report covered handling of materials and supplies, accounting for material received, accounting for material issued and material on hand. A paper on store department expenses was presented by E. L. Fries, auditor of disbursement, Union Pacific R. R. This paper presented a concise exposition of the expenses chargeable to, and the distribution of, store department expenses with a view of standardizing the methods and practices.

The committee on standardization of tinware reported that it was working with a committee from the American Railway Master Mechanics' Association, and would present its report at the June meeting of the latter association.

The committee on uniform grading and inspection of lumber submitted a majority and a minority report, the latter being signed by W. H. Clifton of the B. & O. He advocated the inspection of all lumber at the points of shipment. The committee was unanimous on the following:

First. That all piling and track ties should be inspected when received and loaded at shipping points.

Second. That all material which is termed direct shipments, that is, shipments for construction whether it be bridge or building material should be inspected before loaded or rather at the shipping point for the reason that it is seldom that you have practical men where the material is unloaded to inspect and receive it and if you do not have practical men to unload and receive the material, inferior material is often accepted and used.

Third. Lumber which is shipped direct for any purpose ought to be inspected when loaded at the shipping point.

The majority report, slightly amended, was adopted as recommended practice and referred to the American Railway Association.

The committee on a Railway Storekeepers' Standard Book of Rules presented a 146-page book to be used as a foundation. It was approved and adopted with a few changes.

A paper on handling of stationery was read by S. C. Pettit, stationer, Grand Trunk Railway. He expressed the opinion that stationery should be kept in the general office building, to enable the stationery agent to be in close communication with general officers who are all interested in the forms used in connection with the work of their departments and frequently call for copies of such forms on short notice.

The committee on piece work stated that there is but little more to add to what had already been presented to the association in regard to the establishing and maintaining of the "piece work" or "unit" system of handling supplies and material in the store deparment.

The increased efficiency, as also the advantages and economies which can be and which are being effected through the medium of a well organized piece work system, established and conducted on sound business principles, have already been fully covered by very able papers presented to the association. This report was adopted as recommended practice.

The committee on scrap classification was not ready to report. The committee on marking couplers was continued.

ASSOCIATION BUSINESS.

The following officers were elected: President, G. G. Allen, Chicago, Milwaukee & St. Paul; first vice-president, H. C. Pearce, Seaboard Air Line; second vice-president, J. G. Stuart, C. B. & Q. The secretary-treasurer is to be elected by the executive committee The report of the secretary-treasurer showed a membership of about 700 and a cash balance of $700. The Railway Materials Association elected C. B. Yardley, Jr., as president, and J. Parker Gowing, secretary-treasurer.

WESTERN RAILWAY CLUB.

The annual meeting and entertainment of the Western Railway Club was held at the Hotel Sherman, Chicago, on May 26. The new officers elected are as follows: President, E. W. Pratt, C. & W. Ry.; first vice-president, H. H. Harvey, C. B. & Q. R. R.; second vice-president, J. H. Tinker, C. & E. I. R. R.; secretary-treasurer, J. W. Taylor, Karpen building, Chicago. The following new directors were elected: A. R. Kipp, J. M. Barrowdale and W. E. Dunham. After the new president, Mr. Pratt, had obtained speeches from all possible, the curtain went up (or rather was drawn) on the vaudeville entertainment, which was opened with a selection by the Western Railway Club band. Among the black face gentlemen who did the funny work were W. E. Kelly, Gus Voss, G. H. Porter, J. H. Kuhns, A. F. Young, Frank Ryan, Fred Hickey, C. M. Baker, J. E. Axtell and Jack Ponic. Also mention must be made of musical director J. Will Sousa Johnson—he had surrounded himself with such a musical air that one hardly recognized him. Great credit is due those who gave their time to make the evening a success. The band did especially well and is now one of the club's institutions.

FUEL EFFICIENCY*

By Robert Collett.

An innovation, as I understand it, means, Doing some old thing in a new way or to make changes in something already established. Our work has not been so much on the order of attempting new methods, but rather an attempt to follow to a conclusion methods that were pretty generally known.

The nearest thing to an innovation has been an endeavor to find out what we were doing, what we ought to do, and how to do it. This has been mentioned before, but it is worth repeating and is worth keeping continually before us. The saving was brought about by everyone finding out as much as he could about the business and telling someone who was in a position to correct it, something about the things that were wrong. There is scarcely an item connected with the operation of trains that does not have some influence, and scarcely an employe but that can assist in some way in reducing the fuel bill. A good flue borer is one of the most important men on the railroad. A good way to find out about anything is to do it yourself, and that is one idea that has been followed up with our boys on the different divisions, to find out what each man's needs were, and try to assist in ironing out any difficulties surrounding the work. There has been a great deal of help and encouragement given by all departments, mechanical, fuel and transportation, in fact, there is hardly any department any more on the Frisco, we are just one large family and we have come to be pretty broad gauged in the matter of discussing our limitations with each other and inviting criticism.

Getting back to the engines—we used to think that we had to do a lot of shifting around of things in the front ends of the engines, but we commence at the other end now. If everything is all right there we apply the water cure. It is a wonderful detective. Most of the engineers won't run engines that are choked in the exhaust passages now, they can't make the time or pull the tonnage with them. Formerly we reduced the tonnage to the condition of the engine. Some of you engineers who like a free working engine would scarcely believe that at one time we ran a 705 class engine with a 4¾ nozzle with a ½-inch square bridge, and the 1200s with as small as 4¾-inch nozzle, and then swore at the engines because they wouldn't go anywhere.

*Extracts from an article in the Frisco Man.

We have learned a lot of things and put into effect some other things that we already knew but had grown somewhat careless in; for example, we found that we did not give our ash pans half enough air. It would be a long chapter of experiences to tell of all of the things that have been suggested, and most of them worked out with a view of improving the engines and the fuel consumption. Not all of the things we would like to have done have been put into effect, but the improvement has been gradual and steady. A very great many suggestions came from engineers and firemen, and when we found one man who had a good "kink" about the running or firing we told the other fellow about it who hadn't got next to that particular scheme, and perhaps we got one from him to give to someone else and so on down the line.

There is a lot of hard work connected with locomotive and train operation, but it is always interesting, and it is a man's work to get the best results from the manipulation of the handles in the cab, especially on the recent types of locomotives. One of the most important handles is attached to the scoop shovel.

We have done well, but we don't want to stop at that. We want other railroads to look at the Frisco as the place where fuel is used properly and locomotives, whether superheaters or otherwise, operated in the most scientific way possible.

What can we do to make further improvement, and how much do we lack of obtaining maximum efficiency? On March 26th engine 1298 from Ft. Scott to Kansas City used eight tons of coal, 92 lbs. per 1,000-ton mile. The average for the Kansas City subdivision for the month in through freight was 166 lbs. Average tons per train was 1,545 tons, tons handled on above trip, 1,775. If we could arrange for all engines to make a similar performance we could save, in through freight alone on that subdivision, at $2 per ton, $4,245.20. There would be a 45 per cent saving. A similar reduction in our total fuel bill per month would be $140,041.80. For not obvious reasons this is not possible, but every step in that direction helps that much. Light tonnage, double-heading, and many other items have a bearing, but by all concerned giving special attention the railroad company will have a great deal more money than they now have to spend on locomotive and car repairs, track maintenance, etc. The management would like very much to clean the engines, and will when the money is available. Lets all get busy and make a good start toward saving this money out of the coal bill. I know a great many of the chief dispatchers, yard masters and callers, and most of the engineers and firemen, and I never talked to one of these men yet who opposed a practical suggestion. I am, therefore, going to suggest a few things for us to keep an eye on—not "Don'ts" but "Do's":

Mr. Chief Dispatcher and Yardmaster: If you can give the roundhouse foreman a line-up of the engines coming in and when, he will be in a position to deliver better engines, also give him good figures on when they are wanted for service—standing under steam a long time wastes coal, and contraction and expansion due to changes in fire box temperature, and the way the injector is sometimes used is bad for flues, and engine may go to leaking about leaving time.

Mr. Roundhouse Foreman: Please teach your fire builders to give the crews the kind of fire you would want if you were firing—have grates in good order, no broken fingers, dump grates level, no holes except of standard size, lost motion up in rigging before fire is built, the ashes from firing want to be left on the grates to prevent clinkers from forming and not shaken through in an attempt to level the grates; keep the superheaters and steam pipes tight, flues clean, valves square

and the blows out, and there isn't anything that will be too good for you.

Mr. Fire-Boy: Be stingy with the blower. If you will watch closely you may not need to use it at all except to kill the gas, and by not letting engine pop may get out of town without having to pump the engine more than once and this might help out on running a tank. Firemen have put on the blower and forgot it until the pop raised. Fire light. I have watched a lot, and the fireman who puts in eight shovels per fire can't make it go twice as far as the one who puts in four shovels per fire. First, last, and all the time, play for a clean fire.

The engineer has a lot to think about, but these things pay —to size up the coal and the fire, and start out figuring on both. Too strong right on the start may partially turn the fire, or jerk a hole in it, having to crowd the fire to fill a hole may mean a dirty fire and a bad trip, better ease off and use the blower a few seconds until you get started right. I know, I've tried it both ways. A clean fire and good lubrication are big factors toward a comfortable trip. It's worth while to notice how strong the injector has to work to maintain the water level or, in other words, to see how light it can be worked and still the engine do what you want it to do. If everything is up to the minute the minimum capacity ought to pretty near do the business.

In a very short time we expect to have a system of records that will show what each engine is costing per mile or per 1,000 gross ton miles handled, for fuel, repairs and lubrication, and with our regular engines on freight this will be an incentive for all to make a good performance.

The future looks very bright. We are fast getting around to the old plan of regular crews on freight engines, and my personal observation thus far leads me to the conclusion that we have very fine locomotives, for each crew says their engine is the best. There are now regular freight engines over about four-fifths of the entire system.

HOT BOXES.*

By O. J. Parks, General Car Inspector, Pennsylvania Lines West.

Of the various defects common to car equipment, the hot boxes represent the greatest detention to car and train movement. The heating of one journal not only delays the particular car en route, but is often the cause of serious detention to other trains carrying passengers, mail, express and freight. In addition to these delays it is frequently necessary to switch the car to shop for the repairs, at a switching cost varying from one to ten dollars, to which should be added the repair cost. It has been stated that the total average cost of the switching and repairs is about $10 per hot box, without taking into consideration the heavy expense of wrecks due to this cause, consequent delay to traffic, etc. The principal items of repair cost are renewal of bearing and sponging one or more times, and frequently the removal of the axle for journal truing or renewal, as may be required, which also calls for renewal of both journal bearings and quite often the renewal of journal box bolts. Further, when the wheels are stripped from the axle, many of them are condemned on account of shop limits for remounting wheels, whereas, if the hot box had not occasioned their removal, they would have continued in service for perhaps six months or a year longer, by reason of the road limits being less severe than the shop remounting limits.

For the purpose of comparison, I will refer to the record of hot boxes on freight cars on our Northwest system for the last six months of year 1912 and the corresponding period of 1913, as follows:

	1912		1913	
Month.	Total Hot boxes.	Average Per 100,000 Car miles.	Total Hot boxes.	Average Per 100,000 Car miles.
July	2,583	7.72	2,251	6.33
August	2,542	7.36	2,161	6.14
September	2,789	8.98	1,860	5.82
October	3,027	9.14	1,739	5.26
November	3,519	10.74	1,504	4.85
December	3,583	11.40	1,541	5.55
Total	18,043	9.19	11,056	5.69

The above figures represent the total number of hot boxes, whether or not they caused detentions.

It will be noted that we had a marked decrease in the number of hot boxes for the six months' period of 1913 as compared with the 1912 period. If the average cost of $10 per hot box is correct, the total number of hot boxes for the six months' period of 1912 would amount to $180,430, while the total number for the 1913 period would represent a cost of $110,560, a difference of $69,870 in favor of the 1913 results.

In the early part of 1913 we started a special campaign against the hot box situation along certain lines, first, to ascertain the originating point of each car developing a hot box, then determine the cause and best way to bring about an improvement. In order to get at the source of the trouble we had our inspectors specify, on their daily hot box reports, the originating point of each car giving trouble, and with this information at hand a traveling inspector was sent to the points from which we were receiving an excessive number of hot boxes, to investigate the conditions and make recommendations for improvement. In addition, we compiled the hot box reports, in statement form, covering five-day periods, showing dates, car initials and numbers, and originating points, these statements being forwarded to the master mechanic of the division on which the cars originated—in other words, this information indicates to him the trouble he is sending to the other fellow. This plan has proven very satisfactory in arriving promptly at the responsibility by location, and entails but about twelve hours labor of one clerk to compile the statements for one month.

I will now proceed to the principal causes for journal heating.

First is the shifting of sponging toward the outer end of the journal box, due to the lateral movement of the box when car is in motion, the end of the axle tending to draw the sponging away from the rear of the journal. An examination of the bearings and axles removed on account of hot boxes will show that heating, in the majority of cases, originated at the rear of the journal.

Second: Sponging too tight, due to an excessive amount of waste, in which case there is usually an insufficient amount of oil, by reason of the waste being too compact, the oil being forced out through the dust guard opening, and in consequence of the dry sponging the journal is wiped dry of lubrication. In brief, when a box is tightly packed there is no space for the oil. Another feature is the tight sponging, although not excessive in amount, but jammed between the journal and side wall of the box, thus acting as a wiper, preventing oil reaching the bearing, and not infrequently, strands of waste are drawn under the bearing, causing journal heating.

Third: Sponging glazed, due to dust, etc., and its not being agitated or set up with the packing knife frequently enough, this condition preventing oil reaching the journal.

Fourth: Sponging wound in balls, or applied in bulk under the journal with separate portions along each side of journal, there being no thread connections, and the top portion acting as a wiper, thus prevents a sufficient amount of oil reaching the bearing.

Fifth: Insufficient amount of oil in the sponging, caused by being siphoned away by loose strands of waste hanging out of the box, particularly in warm weather; also water from snow

*A paper delivered before the Car Foremen's Association of Chicago.

getting into the box, and, the water being heavier, the oil rises and escapes from the box.

Sixth: Excessive amount of oil, which means an insufficient amount of waste; the sponging as a whole in this case falls away from the journal, and the oil, being in excess, is thrown from the box by the momentum of the journal, or escapes through the dust guard opening, leaving the journal without lubrication, as the dust guard opening is below the under side of the journal.

Seventh: Worn-out sponging, short fiber, commonly called "muck" or "mush." This condition gives practically the same result as sponging with excessive amount of oil, as it tends to settle below the under side of the journal.

These are the most prominent conditions leading to hot box trouble; however, there are many other conditions of less frequency, such as journal bearings and wedges, worn out, broken, or not seated properly; broken or defective journal boxes, allowing oil to leak out; journal box lids and dust guards missing or improperly fitting; journals worn beyond limits, journals improperly finished or otherwise defective; bent arch bars, broken truck holsters, spring planks, truck frames, etc., causing journal bearings to cock; truck springs solid, axles bent, wheels bored out of center, and slid flat wheels, the latter frequently causing broken bearings or wedges, or their displacement, lading not properly distributed, or above limit load; side bearings with insufficient clearance, preventing alignment of truck, thus causing undue strain on bearings; heavy shocks in switching, causing displacement of journal bearings and wedges, and in some cases particles of waste are thrown under the bearings at this time; bearings, wedges, etc., displaced in handling cars on unloading machines, etc.

A few remarks on so-called epidemics: I claim that, aside from unavoidable conditions, such as floods, etc., there is no occasion for an epidemic of hot boxes. My experience has been that an epidemic usually follows the "let-well-enough-alone" practice, and when the epidemic arrives everybody gets busy and by concerted action the boxes are put in ship-shape, which, however, requires considerable time; then when the conditions become normal the let-well-enough-alone rule is resumed until the epidemic returns again, which may occur two or three times a year. There is no question but that this system is wrong in principle and that far better results can be accomplished by constant attention to the boxes, and with the same force.

I believe that the average man engaged in this line of work is thoroughly familiar with the common causes of journal heating, and understands the proper method of packing and caring for journal boxes, and I do not hesitate to say that if he will exercise careful diligence and each fellow do his share, the hot box problem will be practically solved. Further, we should not lose sight of the opportunity for the caring of this detail of the car when on repair tracks for repairs of any nature, both as to careful attention to the sponging and to the various other conditions about the truck which contribute to hot boxes. Statistics show that there are about two and one-third million freight cars in the country, and, on the average, they are shopped about twelve times per year. If thorough attention were given all of the boxes each time the car is on the repair track, it would not be necessary to use so much oil and sponging while the car is in service.

I want to say that I am a strong advocate of the use of prepared sponging, together with the proper use of the knife and hook, instead of the indiscriminate use of the oil can, while I appreciate that the oil can may in some instances be used to advantage where the sponging is in proper position and in good condition, but lacking oil. On the other hand, if the oil can is indiscriminately used, the sponging when not in good condition or not in proper position will ordinarily be overlooked, and the introduction of a little oil does not give the results. Briefly, the general use of the oil can will lead to sponging out of position and in bad condition, whereas, if the other method be carefully followed, this condition will not obtain. A few years ago it was the ambition of the average car oiler to use as much oil as possible, as he thought his services were measured by the amount of oil he used, and the result was that a large amount of the oil which was poured into the front of the box escaped to the ground through the dust guard opening in the back.

We have found that the best results are obtained by the use of a packing knife having an effective fish-tail point, in setting the sponging back in proper position, which should be done promptly on arrival of car at inspection point, while the sponging is still flexible from normal running heat, this prompt attention being particularly advantageous in the winter months, but is also desirable during the warmer months, taking into consideration other defects in connection therewith, which can be detected at this time and promptly repaired, thereby avoiding unnecessary delay in departure yards.

It should be known before the departure of a car in train that the journal boxes are in good condition, notwithstanding the fact that to have it so will sometimes mean delay—better delay the car in the yard than on the road.

Another feature to which I would refer is the practice followed by some of the roads in marking with chalk, or otherwise, the date of journal box attention, with the understanding that where these dates are within ten, twenty, or perhaps thirty days, the box lids need not be raised unless there are external indications of trouble. This practice is entirely wrong. At points where oilers are maintained, all box lids should be raised and if the oiler is competent he can discern at a glance what attention, if any, is necessary. On the other hand, however, I consider that the dating or marking of journal box attention is a good practice, in that it affords the local foreman in charge of the force a ready means of check against the work of the oilers.

The most important requirement for control of the hot box situation is eternal vigilance—look out for the back of the box, this is the big bug.

THE BIG MEN.

The big men dare, and the big men do,
They dream great dreams, which they make come true;
They bridge the rivers and link the plains,
And gird the lands with their railway trains;
They make the desert break forth in bloom,
They send the cataract through a flume
To turn the wheels of a thousand mills,
And bring the coin to a nation's tills.
The big men work, and the big men plan,
And, helping themselves, help their fellow man.
And the cheap men yelp at their carriage wheels,
As the small dogs bark at the big dogs' heels.
The big men sow while the cheap men sleep,
And when they go to their fields to reap,
The cheap men cry,
"We must have a share
Of all the grains that they harvest there!
These men are pirates who sow and reap,
And plan and build while we are asleep!
We'll legislate till they lose their hair!
We'll pass new laws that will strip them bare!
We'll tax them right and we'll tax them left,
Till of their plunder they are bereft;
We'll show these men that we all despise
Their skill, their courage and enterprise!"
So the small men yap at the big men's heels,
The fake reformer with uplift spiels;
The four-eyed dreamers with theories fine,
Which bring them maybe three cents a line;
The tin horn grafters who always yearn
To collar coin that they do not earn.
And the big men sigh as they go their way;
"They'll balk at the whole blamed thing some day!"

—Walt Mason.

Training Apprentices on the Canadian Pacific

By Lacey R Johnson, General Superintendent, Angus Shops District

You cannot make a silver teapot out of a tin plate, or a strong beam from an unsound log, nor can you make a good mechanic of a boy without some education and a good, sound body and constitution; consequently every applicant for apprenticeship on the Canadian Pacific must be at least 15 years of age in order to have been at school long enough to acquire a good elementary education, and not over 18, so that he may be out of his time when he becomes of age.

At one time sons of employees of the company were given precedence over all other applicants, but it was found that workmen's sons were rushed into the shops with the idea of swelling the family income, regardless of their standard of education, and before they were really strong enough to stand the physical strain imposed upon them by their work, with the twofold result of poor, weak, puny manhood and very second class ability as tradesmen. So for some years past the practice has been to accept the application of any boy of respectable parents who is anxious and shows an aptitude to become a mechanic. If he can pass the necessary examination in reading, writing and arithmetic, according to the standard set by the company, he is sent with a standard form to the medical officer, and if the report is satisfactory his name and address are filed. When a vacancy for an apprentice occurs the boy first on the list is sent for and started in the shops for a probationary term of six months, with the understanding that if he applies himself and shows by his general conduct that he is fitted and anxious to become a good mechanic he will at the end of the probationary period, together with his parent or guardian, sign an apprenticeship agreement (see illustration) in which he promises to abide by the rules and regulations laid down by the company; a duly authorized officer of the company also signing his approval of the contract. The term of apprenticeship is usually from 4 to 6 years, according to the boy's age, but no boy is considered as out of his time until he is 21 years old, although the company reserves the right to cancel the agreement, after due investigation and for sufficient cause. If, during the probationary period, a boy shows continual want of interest, lack of aptitude or general carelessness, his services are dispensed with, as it is considered unfair to the boy and the company to keep him in an employment for which he is unfitted, when he might do well in some other calling.

Each boy spends two hours twice a week in the instruction room, where a staff of qualified instructors are employed. The boys attend in relays of about 20 at a time, during working hours, and are paid the same rate as if working in the shop. Each boy is taught individually according to his capacity, so that the better educated and quicker boys are not held back by the slower ones. This is the result of experience, and works out much better than class teaching, the slower boys being treated with patience and encouraged by the instructors, instead of being made to feel downhearted because they are unable to keep up with the class. Sometimes these boys who are slow at first, by a little extra attention at the beginning, catch up with the others by the time they reach the end of the course.

A regular syllabus of instruction is set out for the different trades to which the boys are apprenticed and the text-books used are those issued by the International Correspondence Schools, supplemented by working models of every kind of locomotive valve gear (made by the boys), sections of injectors, valves, etc. Each boy, no matter what trade he is learning, is taught shop arithmetic, the rudiments of steam and applied mechanics, freehand sketching, mechanical drawing, and practical geometry, the company supplying each boy with a drawing board, T-square, set squares and a set of drawing instruments, which become his property when he has completed his apprenticeship.

Apprentices in Instruction Room, C. P. R.

Annual examinations are held, and prizes given for their encouragement, and, in addition, free scholarships in the International Correspondence Schools every year, in the proportion of one scholarship to every 30 apprentices. They are very keenly contested for. The president of the road also offers every year two free scholarships in the faculty of applied science of McGill University, subject to competitive examination, to apprentices and other employees on the permanent staff of the company under 21 years of age and to minor sons of employees.

In the shop a staff of "shop instructors" are employed who

Lacey R. Johnson and Group of Apprentice Instructors, C. P. R.

are all expert workmen in the different branches of work. They take full charge of the boys during shop hours, teaching them the details and manipulation of the various machines, the best kind of machine for handling the different operations, and the proper way of setting up the article in the machine; also the right kind of tool to use. The instructors have nothing else to do but supervise their work, thus relieving the foremen of all the responsibility in connection with teaching apprentices their trades and leaving them entirely free for their legitimate duties of looking after the output of their shop. A regular schedue is laid down, allotting so much time for every apprentice in the different departments, as it has been found that if a boy made himself particularly apt or useful in any line of work a foreman was very liable to keep him for a very long time, instead of moving him on to another branch, the boy suffering in his general knowledge

CANADIAN PACIFIC RAILWAY COMPANY

APPRENTICE DEPARTMENT

191

The undersigned, residing at

agrees that ... shall serve the CANADIAN PACIFIC RAILWAY at the , as a Apprentice, for the full term of years, commencing Each year to consist of two hundred and ninety (290) working days worked, and time lost from this must be made up before advancement to the next year.

He shall be subject to the rate of pay and rules governing the services of employees issued by the Company.

He shall not be allowed to join any Trades Union until he has completed his full term of Apprenticeship.

THE CANADIAN PACIFIC RAILWAY COMPANY reserves the right to dismiss the Apprentice for cause.

The Company will upon the completion of a satisfactory Apprenticeship grant the Apprentice a Certificate of Apprenticeship.

This Apprentice will not be released until he is 21 years of age.

Guardian or Parent's Signature

Apprentice's Signature

Witnessed on behalf of the Company

Declared to before me this

day of 19

Approved

Head of Department

Commissioner for taking affidavits for Superior Courts.

Province of Quebec.

Apprentice Agreement, C. P. R.

APPRENTICE RECORD CARD

NAME TRADE DATE

Age

Born

Address

Signed Agreement

Medical Cert.

STAFF ALTERATIONS

2nd Year App. @

3rd " " @

4th " " @

5th " " @

Out of Time

PREVIOUS SERVICE

TIMEKEEPING IN SHOP

	19	19	19	19	19	Total
Times Late						
Hours Lost						
Hrs. Overtime						

ATTENDANCE IN SCHOOL

	19	19	19	19	19	Total
Present						
Absent						
Late						

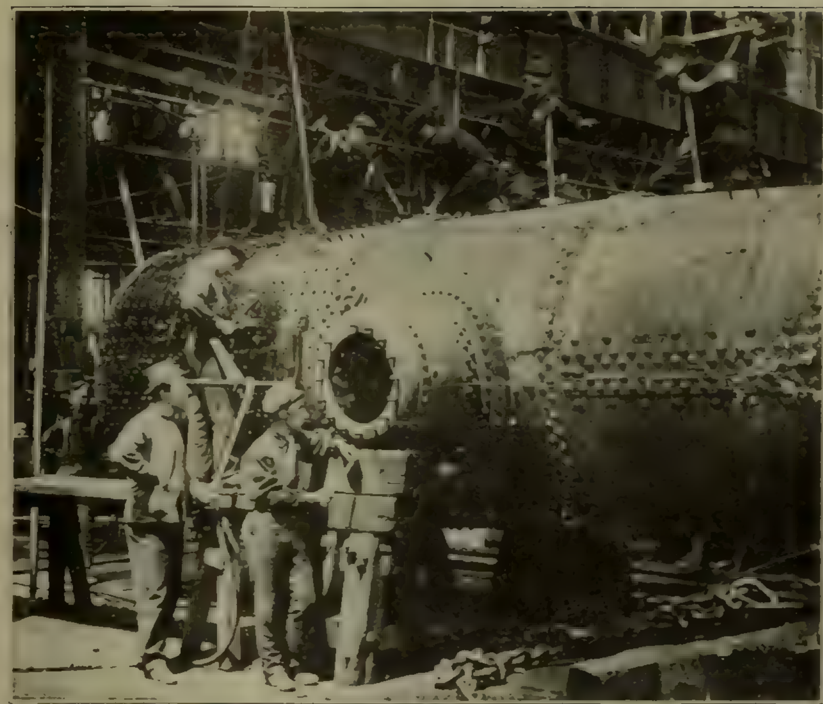
RECORD OF SERVICE AT ANGUS

Record Card.

	SHOP PROGRESS						SCHOOL PROGRESS
	19	19	19	19	19	19	
JAN.							
FEB.							
MAR.							
APR.							
MAY							
JUNE							
JULY							
AUG.							
SEPT.							
OCT.							
NOV.							
DEC.							

Reverse Side of Record Card.

C. P. R. Apprentices at Ambulance Work.



C. P. R. Apprentices in Boiler Shop.

accordingly. In order to guard against this, the shop instructors are held responsible for moving the boys according to the schedule. Should, however, a boy show himself slow to master any of the details in any branch, the instructor may delay his move for a time, but the case must be reported to the chief supervisor and recorded. On the other hand, if a boy proves very quick in mastering any branch, the time may be shortened by following the same procedure. The instructors report on every boy monthly, on a proper form, as to progress made, regularity of attendance, and punctuality. This system has proved very satisfactory.

Apprentices are allowed all the statutory holidays and fifteen days summer holidays, but must work 290 days each year in order to get the annual advance in pay, as per schedule. This system of holding back the annual increase of a boy who is inclined to be irregular in his attendance is much more satisfactory all around than suspending him for so long, as every boy is keen to get the increase in pay, and it also brings the parents' influence into play, as it affects the family income.

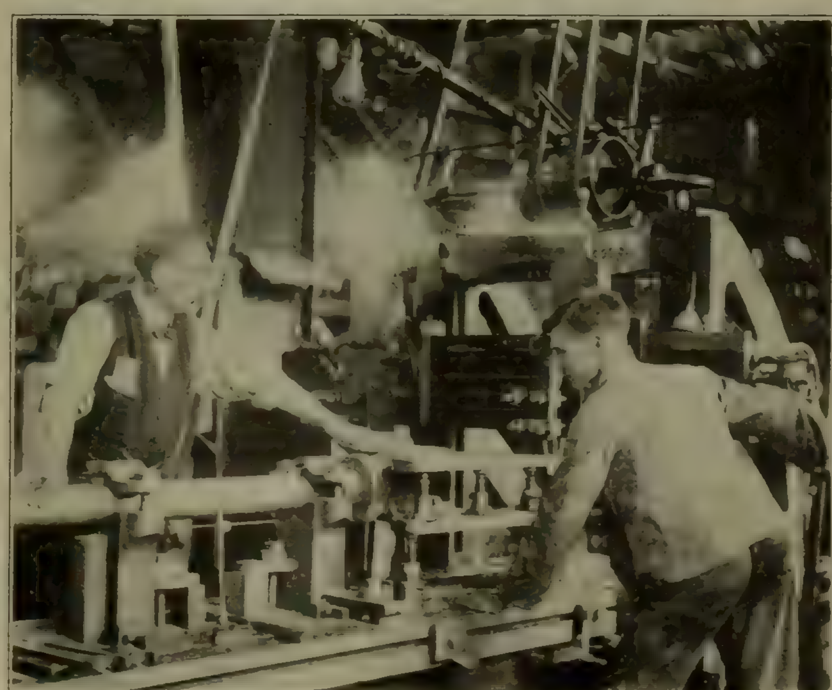
Any apprentice who shows evidence of skill in drawing is given six months in the drawing office (either locomotive or car) during the last year of his apprenticeship, and other boys, as a reward for good record, are given a time in the testing laboratory, under the engineer of tests.

An individual record is kept of every apprentice, on the card system (see illustration) from the day he enters the works until he is out of his time, and these cards are filed away for reference at any time. A certificate of apprenticeship is also given him, giving a synopsis of his record and his qualifications.

During their apprenticeship the boys are encouraged to take a course of instruction in "First Aid to the Sick and Injured," under the St. John Ambulance Association, in order to enable them to treat men in the shops or on the athletic field who may be taken suddenly sick or meet with an accident. This instruction is given to them in the form of lectures by medical men, and practical work, such as arresting hemorrhage, bandaging and artificial respiration, by qualified instructors. This is entirely at the expense of the railway company, a large number of them taking certificates and medallions, and, what is better still, have been the means of saving untold suffering to their fellow workmen by their efficient first aid work in cases of accident, not only in the shop, but also on the football, la crosse, and baseball field and hockey rink, for they are encouraged to join in all outdoor manly sports and exercises, as the company recognizes the advantage to any boy or man of a sound, healthy, well-developed body. In fact, the president of the company himself shows his appreciation of this fact by being honorary president of the athletic association connected with the works, and other executive officers show their interest by giving prizes to be competed for in the field.

The whole-hearted support of the shop officers and foremen helps to insure the success of the apprentice department, and in proof of the success of the system it may be stated that quite a number

C. P. R. Apprentices in Erecting Shop.

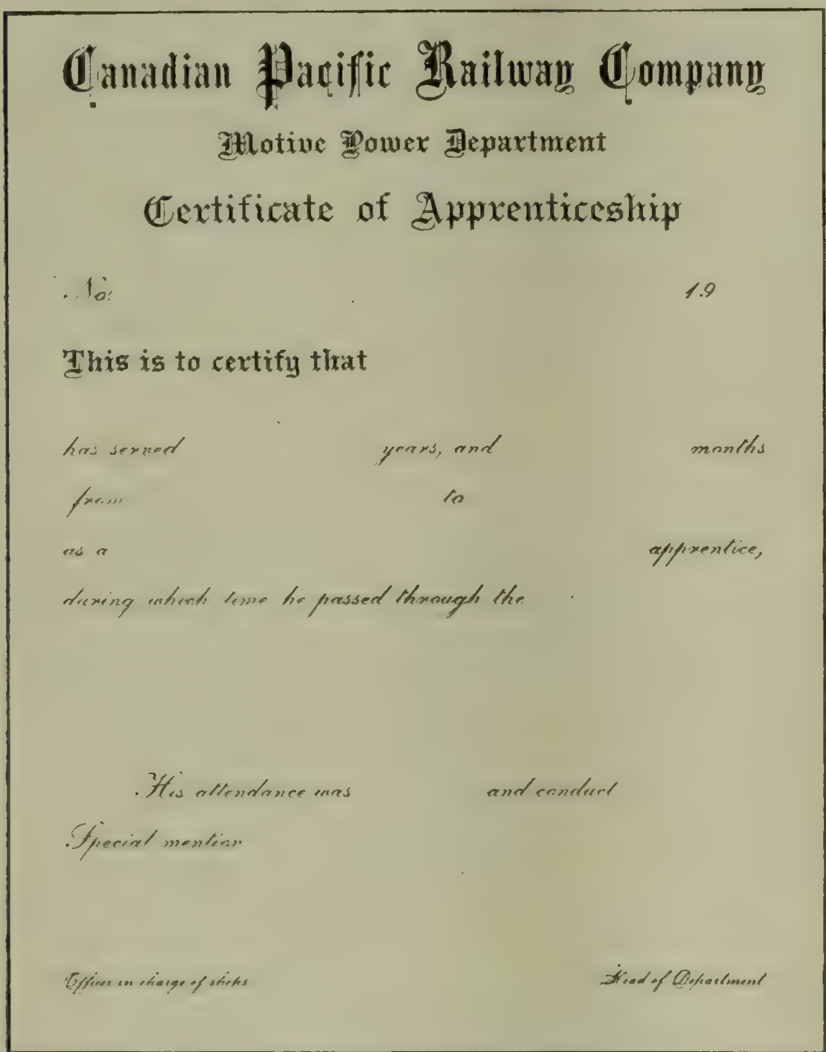


C. P. R. Apprentice in Machine Shop.

of our boys, on completion of their apprenticeship, have been promoted to positions of trust and responsibility in the company's service, while others have taken good positions on other railways, manufacturing and commercial companies. Besides this, our shops are being manned with a staff of intelligent, efficient, and loyal mechanics.

While other roads and other shops are to a certain extent reaping the benefit of our training, 92 per cent of our apprentices remain with the road, and some of those who go away come back in a few years all the better for their experience and bringing back with them new ideas and in many cases broader minds. We never place any obstacle in the way of their going elsewhere for experience.

The following schedules for the work done during the apprenticeship courses indicate a minimum and maximum amount of time the apprentices are engaged on each class of work. These



Canadian Pacific Railway Company

Motive Power Department

Certificate of Apprenticeship

No. 19

This is to certify that

has served years, and months

from to

as a apprentice,

during which time he passed through the

His attendance was and conduct

Special mention

Officer in charge of shops Head of Department

Certificate of Apprenticeship.

are adhered to as far as possible, and the variation allowed is arranged to accord with the aptitude shown by the apprentice in the work, and not used to delay his change from one class of work to another to suit the convenience of the foreman. A record is kept in the office of the supervisor of apprentices of each apprentice, of the work on which he has been employed, and the shop instructors make weekly reports of the work done by each apprentice under his charge. Apprentices need not pass from one class of work to another in the order given, but the time worked on each class of work should be within the assigned limits.

MACHINISTS.

The five-year course for machinist apprentices is as follows:

1. Experience on machines ....24 months
2. Experience on bench work ....18 months
3. Experience in erecting shop ....18 months

In detail:

(1) Experience on Machines.

Shapers and slotters	3 or 6 months
Planers	2 to 4 months
Millers	2 to 3 months
Lathes	4 to 8 months
Drills	1 month
Other machines	2 to 4 months

Total, 14 to 26 months.

(2) Experience on Bench Work.

Class "A."		
Truck Work	Smoke Box Doors	Side Rod Work
Main Frames	Cross Head Work	Air Brake Work
Brass Work	Marking Off Work	Axle Box Work
Class "B."		
Axle Work	Cylinder Work	Air Brake Work
Motion Work	Brake Gear Work	Brass Work
Valve Work	Marking Off Work	Side Rod Work

Apprentices follow either course "A" or course "B," and do not work less than two months or more than three months on any class of work.

(3) Erecting Shop Experience.

Brake gear and spring work, shoes and wedges	2 to 4 months
Motion work	3 to 5 months
Steam chest work	3 to 5 months
Cylinder fitting	2 to 4 months
Valve setting	2 to 4 months
Pop setting	1 to 2 months
Boiler setting	2 to 4 months
General engine work	3 to 6 months
Total	18 to 34 months

BRASS FINISHERS.

The five-year course for apprentice brass finishers is as follows:

1. Experience on machines............3½ years
2. Bench work ....1 year
3. Experience in plating and oxidizing............6 months

In detail:

(1) Experience on Machines.

Drills	9 to 12 months
Millers	9 to 12 months
Lathes	18 to 30 months
Total	36 to 54 months

(2) Experience on Bench Work.

Brass fitting and brass filing	9 to 12 months

(3) Experience on Plating and Oxidizing.

Plating	2 to 4 months
Oxidizing	2 to 4 months
Total	4 to 8 months

Experience in plating and oxidizing rooms is only given to the apprentices who make the best progress.

BOILERMAKERS.

The four-year course for apprentice boilermakers is as follows:

In detail:

Light sheet iron work	18 to 24 months
Marking off work	6 to 12 months
Boiler staying	2 to 4 months
Riveting, chipping and calking	6 to 12 months
Flanging	4 to 9 months

Total, 50 to 82 months.

All boiler apprentices put in from three to six months on rivet heating before they are apprenticed.

PATTERNMAKERS.

The five-year course for apprentice patternmakers is as follows:

General helping in pattern shop	9 to 12 months
Foundry or molding floor experience	3 to 6 months
Bench work	54 to 66 months

Total, 54 to 66 months.

STEAMFITTERS.

The four-year course for apprentice steamfitters is as follows:

General helping in steamfitters' shop	6 to 12 months
Injector and lubricator pipe work	9 to 12 months
Air brake pipe work	12 to 18 months

Total, 36 to 54 months.

PAINTERS.

The four-year course for apprentice painters is as follows:

General helping and paint mixing.............. 9 to 12 months
Rough stuff and plain painting................ 9 to 12 months
Graining, filling and polishing...................12 to 15 months

Total ....42 to 57 months

TOOLMAKERS.

The five-year course for apprentice toolmakers is as follows:

1. Experience on machines in east and west machine shops .... 6 to 12 months
2. Experience on machines in tool shop..........36 to 54 months
3. Bench work experience..........................12 to 15 months

In detail:

(1) Six to 12 months' experience in east and west machine shops.

(2) Experience on Machines in Tool Shop.

Small lathe (repair work)...................... 4 to 8 months
Plain milling machine.......................... 4 to 8 months
Shaper .... 3 to 6 months
Cutter, grinder .... 3 to 6 months
Universal milling machine...................... 4 to 8 months
Various lathes ....12 to 18 months
Machine repair work............................ 3 to 6 months

Total, 36 to 66 months.

(3) Bench Work Experience.

Die, punch and jig work on bench...............12 to 15 months

ELECTRICIANS.

The five-year course for apprentice electricians is as follows:

Experience in machine work.....................12 to 18 months
Assisting wiremen ....18 to 24 months
Repair work (armature winding, motors, instruments, transformers, etc.)................... 9 to 15 months
Installation work ....12 to 18 months
Assisting power house engineers and switchboard attendants .... 3 to 6 months

Total ....54 to 81 months

CAR BUILDERS.

The five-year course for apprentice car builders is as follows:

Helping bench carpenters.......................12 to 15 months
Construction of passenger and freight car trucks. 9 to 18 months
Construction of passenger and freight car platforms (iron) .... 6 to 13 months
Construction of passenger and freight car platforms (wood) .... 6 to 13 months
General car detail work........................12 to 24 months

Total, 54 to 101 months.

MOULDERS.

The three-year course for apprentice gray iron molders is as follows:

Helping around shop............................ 3 to 6 months
Light work .... 6 to 9 months
Loam work and coremaking....................... 9 to 15 months
Furnace work .... 3 to 9 months
Machine molding .... 6 to 12 months
General work ....12 to 18 months

CABINET MAKERS.

The four-year course for apprentice cabinet makers is as follows:

Helping in cabinet shop........................ 6 months
Bench work ....30 to 40 months
Machine work .... 3 to 6 months
Outside work .... 6 to 12 months

BLACKSMITHS.

The four-year course for apprentice blacksmiths is as follows:

Hammer and helping around shops................ 3 to 12 months
Light fire work.................................18 to 24 months
General work ....24 to 26 months
Heavy fire work................................ 6 to 12 months

C. P. R. Apprentice Foot-ball Team.

PLUMBERS.

The four-year course for apprentice plumbers is as follows:

Helping around shops........................... 3 to 6 months
Helping plumbers ....12 to 24 months
Jointing, bending, wiping, etc.................12 to 24 months
General plumbing ....24 to 36 months

CARPENTERS.

The four-year course for apprentice carpenters is as follows:

Helping around shops........................... 3 to 6 months
Machine work .... 3 to 6 months
Bench work ....18 to 24 months
Inside or outside car work.....................24 to 36 months

ADVANCEMENT OF APPRENTICES.

Apprentices receive their annual increase of pay who satisfy the three following conditions:

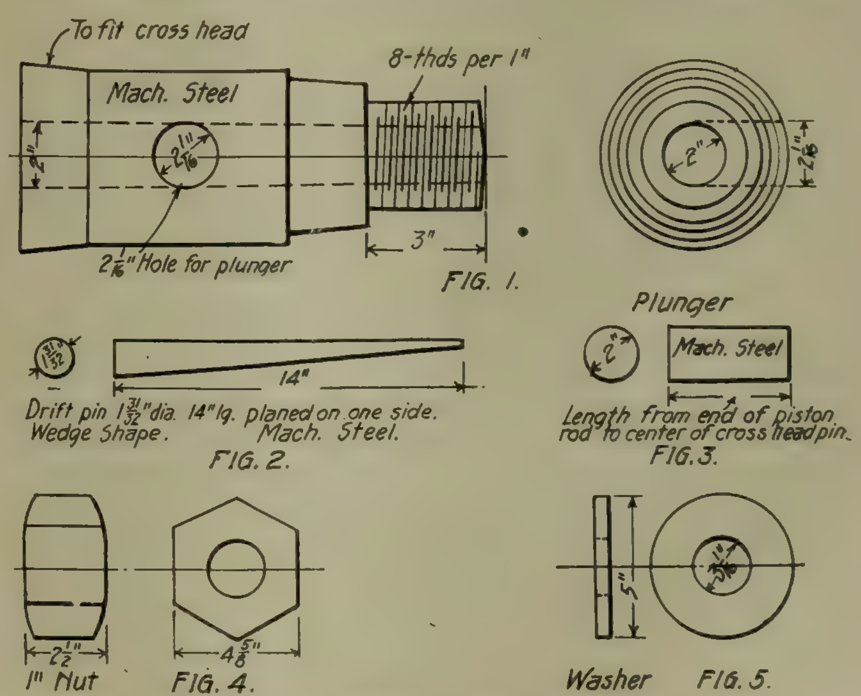
(1) Regular attendance and punctuality.
(2) Satisfactory progress in shop work and favorable recommendation of his shop instructor and foreman.
(3) Satisfactory progress in the apprentice instruction class, and favorable recommendation of his educational instructor.

PISTON PULLER.

By J. A. Elliott, Air Brake Fmn., I. C. R. R.

There has been quite a number of devices used for removing a tight piston from a crosshead, but we find the one in the accompanying sketch gives the very best results, with the least expense for the upkeep of the tool.

Crosshead pin, Fig. 1, is made to fit a certain class cross-



Piston Puller.

head and 2" hole is bored through center for drift pin. A $2\frac{1}{16}$" hole is also drilled through one side of bearing to drift pin hole, for plunger. The pin is threaded for 3" 8-thread nut, $2\frac{1}{2}$" thick.

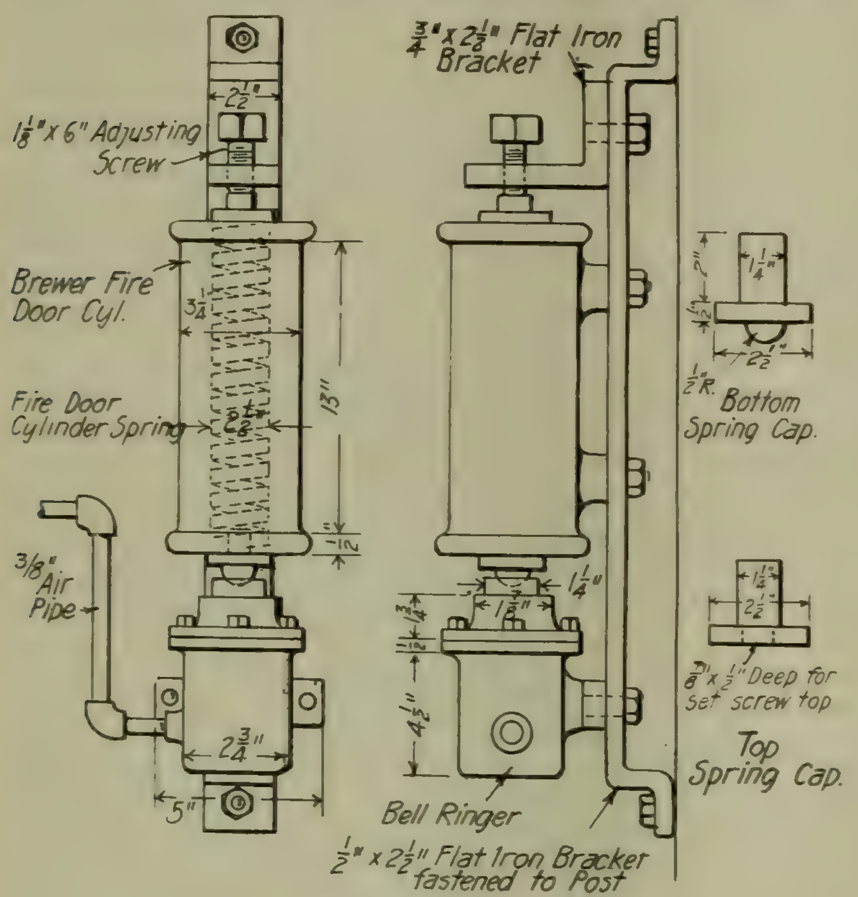
Drift pin (see Fig. 2) is $1\frac{31}{32}$" diameter, 14" long, and is planed wedge shape on one side. Plunger (Fig. 3) is 2" diameter, made long enough to reach from end of piston to center of drift pin hole in crosshead pin.

To drift a piston from crosshead, crosshead pin, Fig. 1, is applied to crosshead and plunger (Fig. 3) is put in position. Then washer (Fig. 5) is applied and nut (Fig. 4) tightened up with wrench. Now drift pin (Fig. 2) is inserted with planed side against plunger. Two or three good blows with a sledge hammer will loosen the tightest piston.

DEVICE FOR TESTING BELL RINGERS.

By J. A. Elliott, Air Brake Foreman, I. C. R. R.

It is very trying sometimes to get a bell ringer to work satisfactorily after it has been repaired and new rings have been fitted. This has to be done frequently on account of rings being rather heavy for such small diameter (2") and there being four



Bell Ringer Tester.

in the cylinder which causes the piston to work stiff until rings are wore down to a bearing. When the bell works a little stiff in the bell frame (which is always the case when frame is overhauled and new frame pins fitted) it takes a lot of patience to adjust the bell ringer so that it will operate from the cab without pulling the rope to start it. To overcome this trouble the devise in the accompanying sketch was gotten up. It is very simple and easily made, and saves considerable time in repairing bell ringer too, as you can put it on the rack, turn on the air and let it work without any further attention until rings are worn down to a bearing and piston works free in cylinder. We used an old Brewer fire door opener cylinder and bolted it on a ½x2½ flat iron bracket which is made long enough to bolt the bell ringer and adjusting screw bracket on it also, as shown in sketch. The spring used is a flat coil spring similiar to that used in the Brewer fire door opener, which is about the right tension. To test the bell ringer, bolt it on bracket, turn air on and screw adjusting screw down until spring has enough tension to force piston down after each stroke. The greater the spring tension the faster the ringer will work.

New Books

HANDBOOK OF U. S. SAFETY APPLIANCE STANDARDS FOR FREIGHT CARS. Paper, 32 pages, 4x6 inches. Published by J. D. MacAlpine, Cleveland, O. Ten cents per copy, 75 cents per dozen copies or $5.00 per hundred.

This book contains in a convenient tabulated form all of the dimensions and requirements of U. S. safety appliance standards. They are arranged in such a concise manner that the car inspector can refer at once to the requirements with regard to any particular type of car. With the large number of safety standards in effect and going into effect, this book is almost a necessity to car men.

HOW TO BUILD UP FURNACE EFFICIENCY—By Jos. W. Hays; paper, 5 x 7¼ inches; published by Jos. W. Hays, Rogers Park, Chicago, Ill. Price, $1.00.

This work is at once the most original, instructive and interesting treatise on the subject of power plant efficiency it has been our pleasure ever to review. The amusing "slang" of the author is simply every-day language which in this case is used in the expression of a thorough knowledge of his subject quite evidently based upon considerable experience backed by technical education. It is at best difficult to deal untechnically with a highly technical subject, but Mr. Hays has achieved this end in admirable fashion. The book should be read by every factory general manager as well as by every engineer of a power plant.

Enough of the chemistry of combustion is introduced to explain the necessary processes in gaining greater efficiency, while not placing the text beyond the "ken" of the average power plant operative. The illustrations consist of charts and diagrams with photographs of apparatus, and they really illustrate.

PRACTICAL LOCOMOTIVE OPERATING. By Clarence Roberts, Assistant Road Foreman of Engines, P. R. R., and Russell M. Smith, Air Brake Instructor, P. R. R. Cloth, 292 pages, fully illustrated with 92 cuts and 5 inserts. Published by J. B. Lippincott Company, Philadelphia, Pa. 1914. Price, $2.00.

This book is a "practical" book, written by practical men for practical men. The subjects taken up are those that locomotive enginemen ought to know and those who take a lively interest in their work ought to know something of them, also. In Part I the classes of locomotives are given, the processes involved in locomotive operating, the power of locomotives, train resistance and locomotive efficiency are explained.

The processes involved are combustion, the generation of steam, its utilization, and the impulsion by adhesion of the driving wheels. Some remarks are made about mechanical stokers and the point is clearly brought out that such a stoker is not intended to eclipse economical hand firing, but that the mechanical stoker can do work far beyond the physical ability of the fireman.

The whole rationale of steam generation is gone into, and a table of the properties of saturated steam is given. The authors admit that it is not definitely known how fast heat transfer takes place, but good practice has found, by trial and experience, that if the heating surface goes below 60 or 65 times the grate area heat will be lost, as there will be more than the plates can quickly transfer to the water, and the additional efficiency, if the ratio between the two is much greater, will be too small to compensate for the extra weight and cost.

Next comes tractive effort and horse power. The correct formulas are given and the whole subject is very clearly set forth. The part played by adhesion is explained, and this matter of adhesion is quite important, and it is not usually made to occupy as prominent a place as it should, when tractive effort is considered. In this book it has its proper place.

The friction of the locomotive itself receives attention, and train resistance formulas are given and examples are worked out. There is one ratio constantly given in technical papers which needs explanation. It is that obtained by dividing the tractive effort by the heating surface. To many this seems to be a meaningless

performance, but its value becomes clear when, as the authors point out, that the available tractive effort decreases while the speed increases, because at high speeds the cut-off is early and the mean effective pressure in the cylinders is thereby reduced. Take a given locomotive, for example. Its wheels and cylinders remain constant and the mean effective pressure is the variable. As the mean effective pressure changes the tractive effort changes. Several curves are plotted on a diagram showing how this takes place. When horse power is calculated, mean effective pressure and speed are the two variables, and so at the highest speeds the indicated horse power is a maximum, though the tractive effort is quite small as compared with slow speed. Tractive effort is draw-bar pull less internal friction, but it does not of necessity imply motion, while horse power is the rate of doing work; that is, draw-bar pull actually producing motion. The word "work" is here used in the mathematical sense of pressure acting through space and against resistance.

It is not our purpose to give a close analysis of the whole book; we have instanced these points to emphasize the plain, practical nature of the work.

Under the head of Classification of Locomotives, Part II, the ordinary types come in for definite treatment and the compound is dealt with in detail. The subject is well illustrated and the reason for the various operations involved are told in plain language. There is a table of dimensions and characteristics in which a large number of locomotives running on many railways are given.

Part III opens with a general, easily understood explanation of physics, mechanics, dynamics, heat, temperature, etc., etc. Under the head of chemistry coal is defined and its composition, heat values, etc., are made clear. The meaning and use of the British thermal unit is important, as many fuels are bought nowadays on the basis of heat units, and the relative value of the volatile and the solid constituents of coal are given. It is easy to see that carbon mon-oxide, CO, is the result of incomplete combustion, and this results in the loss of heat which would otherwise be given off if carbon dioxide, CO_2, was formed. An interesting proof of this may sometimes be seen at the top of chimneys in rolling mills, etc., when carbon mon-oxide is formed in the furnace and carried up the flue as a very hot smoke. At the top of the chimney, when meeting the air, it bursts into flame and CO burns to CO_2, thus completing the combustion without raising the temperature of the furnace.

Part IV deals with steam, states Boyle's or Marriott's law, and gives a comprehensive table of physical properties of saturated steam. The generation of steam and the work done in its formation are interesting subjects, and the expansion of steam and cylinder condensation naturally follow in the book. The advantages of superheated steam are set forth, and it easily becomes clear to the reader what happens and where economy comes in with a cylinder which may be supplied with superheated steam approximating to a perfect gas, with margin enough to meet inevitable cooling, and the same cylinder where saturated steam, close to the dew point, is supplied, which is little better than high pressure fog. Part V is devoted to boilers, and in this section classes and types appear, construction features, superheaters, draft appliances, safety devices, parts and appurtenances, with boiler power data. The section closes with some practical comments on injectors.

Part VI takes up lubrication and lubricants. Part VII follows with cylinders, valves and valve gears. Part VIII is eminently practical and deals with running and firing. Here the rationale of whole process of understandingly managing an engine with due care and economy is brought out. The values of the volatile hydrocarbons and the fixed carbon, with the results of experience and tests, are given to the reader with directness, and the why and wherefore is followed out to the end.

Part IX deals with disorders, deteriorations, pounds, blows and breakdowns. Part X, under the head of parts and appliances, takes in the brick arch, injectors, water gauges, lubricators, pop safety valves, flexible staybolts, and all the many et ceteras that should be understood by those running, maintaining, caring for or designing locomotives in any way.

Part XI is concerned with operating conditions, qualifications and responsibilities of employees, co-operation between enginemen, health, and first aid. It closes with a series of questions on the subjects taken up all through the book. Part XII gives the United States Federal laws respecting boilers and safety appliances.

The work, it may be said, is the latest word on running and firing. Enginemen spend about half their time on engines, hence it is important for them to become familiar with all the parts and appliances on the machine, and to know the latest approved practices in running and firing, particularly concerning those types of engines equipped with superheaters, brick arches, and improved valve gears. These appliances have made possible a great increase in locomotive efficiency, and for their proper operation a demand has been created for progressive men with a high standard of intelligence. This book contains the information that locomotive engineers, firemen and others ought to possess in order to enable them to pass necessary examinations. A study of the subjects presented encourages men to think, which is the best means of education, and it helps to develop their faculties in solving the various problems which arise in locomotive operating. The work is designed to teach the high value of efficiency, not only for its own sake, but because the knowledge of the science of locomotive operation gives to the man who possesses it a legitimate feeling of security and self-reliance, and this develops into the strong and able man. GEO. S. HODGINS.

Personals

J. T. LUSCOMBE has been appointed master mechanic of the *Baltimore & Ohio* at Parkersburg, W. Va. He succeeds J. B. Elliott.

H. SHOEMAKER has been appointed mechanical superintendent of the *Bangor & Aroostock*, with office at Derby, Me.

H. C. GRIFFIN has been appointed general car inspector of the *Canadian Pacific* at Montreal, Que., succeeding L. C. Ord, promoted.

F. B. FISHER has been appointed master mechanic of the *Central New England* at Hartford, Conn. He succeeds A. A. Harris.

J. E. DOUGHERTY succeeds F. B. Fisher as traveling engineer of the *Central New England* at Poughkeepsie, N. Y.

F. C. RUGGLES succeeds P. L. Drescher as general foreman of the *Chicago & Eastern Illinois* at Villa Grove, Ill.

L. A. RICHARDSON has been appointed mechanical superintendent, first district, of the *Chicago, Rock Island & Pacific*, succeeding H. C. Van Buskirk, resigned. His headquarters are at Des Moines, Ia.

R. L. STEWART succeeds L. A. Richardson as mechanical superintendent, third division, of the *Chicago, Rock Island & Pacific* vice L. A. Richardson, promoted. His office is at El Reno, Okla.

P. J. COLLIGAN succeeds R. L. Stewart as master mechanic of the Chicago terminal division of the *Chicago, Rock Island & Pacific* with office at Chicago.

W. M. WILSON has been appointed master mechanic of the El Paso division of the *Chicago, Rock Island & Pacific* succeeding P. J. Colligan, promoted. His office is at Dalhart, Tex.

P. SMITH has been appointed road foreman of equipment of the *Chicago, Rock Island & Pacific* at Chicago, Ill., succeeding William Germer.

WILLIAM H. MAYER was recently appointed superintendent of the *German American Car Co.*, shops at Sand Springs, Okla. Mr. Mayer commenced railway work in February, 1888, on the Big Four, and in May, 1895, went to the Lake Shore & Michigan Southern as car inspector. In April, 1898, he returned to the Big Four as rip track foreman, and on April 16, 1906, was appointed foreman of the car department at Bellefontaine, O. This position he held until March 11, 1914, when he accepted the above mentioned position.

ANDREW GUILD succeeds E. Kimana as master mechanic of the *Hawaii Railway*. His headquarters are at Makukona, Hawaii, H. I.

M. Afflaque succeeds R. Blum as master mechanic of the *Hilo Railroad*, with office at Hilo, Hawaii, H. I.

George Terry has been appointed acting roundhouse foreman of the *Intercolonial* at Pt. du Chene, N. B., vice Edward Doyle.

W. T. Madden has been appointed acting car foreman of the *Intercolonial* at Moncton, N. B., vice R. L. Blake.

C. E. Oakes succeeds W. M. Bosworth as mechanical engineer of the *Kansas City Southern*, with office at Pittsburg, Kan.

John Feld succeeds P. H. Maley as boiler shop foreman of the *Minneapolis & St. Louis* at Marshalltown, Ia.

H. L. Miller has been appointed roundhouse foreman of the *Minneapolis & St. Louis* at Minneapolis, Minn. He succeeds W. W. Murray.

H. S. Rauch succeeds J. Fleming as general foreman, locomotive department, of the *New York Central & Hudson River*, with office at Avis, Pa.

P. R. Richards succeeds J. T. Brady as superintendent of shops of the *New York, New Haven & Hartford* at Readville, Mass.

F. E. Ballda has been appointed superintendent of shops of the *New York, New Haven & Hartford* at New Haven, Conn., succeeding P. R. Richards.

A. A. Harris succeeds F. E. Ballda as master mechanic of the *New York, New Haven & Hartford* at East Hartford, Conn.

R. H. Hunter has been appointed traveling engineer of the *Oregon Short Line* at Glenns Ferry, Ida., succeeding H. W. Joslyn.

E. Thomas succeeds George Ross as master mechanic of the *Oregon-Washington R. R. & N.*, at La Grande, Ore.

J. J. Shaw succeeds L. E. Foote as master mechanic of the *St. Louis & San Francisco* at Francis, Okla.

George Burns succeeds J. J. Shaw as master mechanic of the *St. Louis & San Francisco* at Enid, Okla.

C. Nelson has been appointed general foreman, car department, of the *St. Louis & San Francisco* at St. Louis, Mo.

W. S. Stevenson succeeds James Early as division foreman of the *St. Louis & San Francisco* at Oklahoma City, Okla.

Z. B. Claypool has been appointed division foreman of the *St. Louis & San Francisco* at Hugo, Okla. He succeeds C. P. Tyler.

R. E. Roe succeeds J. C. Nolan as master mechanic of the *St. Louis, Brownsville & Mexico*, with office at Kingsville, Tex.

J. C. Nolan has been promoted to superintendent of the *St. Louis, Brownsville & Mexico*, with office at Kingsville, Tex.

F. W. Corcoran has been appointed oil burning inspector of the *Southern Pacific*, with office at Los Angeles, Cal.

F. C. Keim succeeds A. C. Hinckley as master mechanic of the *Southern Pacific* at West Oakland, Cal.

A. D. Williams succeeds F. C. Keim as master mechanic of the *Southern Pacific* at Stockton, Cal.

W. C. Morgan succeeds W. L. Hack as oil burning inspector of the *Southern Pacific* at Los Angeles, Cal.

W. L. Hack has been appointed road foreman of engines of the *Southern Pacific* at Tucson, Ariz.

J. J. Carey has been appointed master mechanic of the *Texas & Pacific* at Marshall, Tex., succeeding G. H. Langton.

D. E. Sullivan has been appointed master mechanic of the *Union Pacific* at Cheyenne, Wyo.

C. A. Brackett succeeds E. S. Way as general foreman of car repairs of the *Vandalia* at Terre Haute, Ind.

ENDSLEY GOES TO PITTSBURGH.

Louis E. Endsley, well known among railway and supply men and an active member of the Western Railway Club, is leaving Purdue University and in September goes to the University of Pittsburgh as professor of mechanical railway engineering. His department is a new one just being organized in the University of Pittsburgh, and D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West, is taking an active interest in its organization. Through him the students of the University will have access to the testing facilities of the Pennsylvania Railroad, and will be able to visit the Pennsylvania shops and obtain valuable information with regard to the operation of railroads.

One of the main features of this work will be the coöperation of a number of outside men who will be brought in contact with the students. Special men will assist on locomotives, car design, air brake work, etc., these men being the best designers and engineers connected with the various railroads and manufacturing plants in the Pittsburgh district. It is the intention of the University to make this department a great center for the railroad work of the country. The equipment of the laboratories will be developed along the modern lines, dealing with all phases of mechanical railway engineering. Special attention will be devoted to the application of electricity to all departments of the service.

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Louis E. Endsley.

Mr. Endsley was graduated from Purdue University in 1901, and in 1903 was granted the degree of M. E. After graduation he was for two years associated with Dr. W. F. M. Goss in research work. In 1903 he was appointed instructor in the locomotive laboratories of Purdue University, advanced two years later to assistant professor, and one year later to associate professor of railway mechanical engineering.

In 1908 he was appointed professor of railway mechanical engineering and given direct charge of the Master Car Builders' laboratory, which is located at Purdue University. He has had charge of all the tests conducted on the brake shoe testing machine of the Master Car Builders' Association for the last twelve years and has also conducted a great many tests pertaining to superheated steam on the locomotive at Purdue University, presenting papers with regard to this work before the Master Mechanics' Association. He was in direct charge of the locomotive laboratory during the front end tests conducted by the Master Mechanics' Association several years ago.

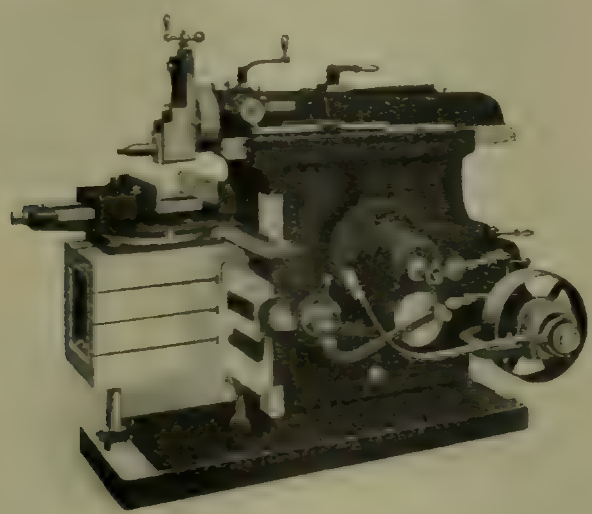
Some years ago he conducted some very interesting tests for the American Steel Foundries on the friction of a freight car truck as affected by the different degrees of curvature. These tests also determined the effect of the old and new wheels upon the friction; the effect of the summer and winter oil upon the friction, and the effect of the condition of the truck as regards its square and loose qualities. Last winter he gave an interesting paper before the Western Railway Club on stresses set up in car-wheel plates due to the heat of brake-shoe friction.

Mr. Endsley is a member of the American Society of Mechanical Engineers; associate member of the Master Mechanics' Association, associate member of the Master Car Builders' Association; member of the Western Railway Club and the Indiana Engineering Society. He is constantly in touch with practical railway work, getting first-hand information from mechanical department men as to their problems, and has many friends in railway circles. With such a man at its head, the mechanical railway engineering department at the University of Pittsburgh will occupy an important place in railway circles and its success is assured.

Among The Manufacturers

HEAVY SERVICE SHAPER.

Among the new machines to be exhibited at the Atlantic City convention this year is a new 24-in. heavy service shaper, by the American Tool Works Co. One of the very first considerations when laying out this new shaper was that of power input. The approximate power a shaper of this size would require for performing the heaviest classes of work was determined, then sufficient extra power added to provide a safe working margin. Consequently this machine is endowed with greater power than will ever be required for the average heavy work, and when doing such work will not be constantly working up to the limit of its capacity. On the speed box driven machine the belt delivers over 14 H.P. to the driving pulley. The new



Heavy Service Shaper.

speed box, designed especially for this machine, is quite different from anything heretofore furnished for the same purpose. It is a complete unit which is absolutely and quickly interchangeable with the cone pulley drive unit; consequently a cone pulley driven shaper can readily be converted to speed box drive without any complications whatever. This unit is located in its proper position on the column by means of dowel pins and is held firmly in place by 10 large bolts.

The speed box drive provides four changes of speed, which combined with the back gear drive produces a total of eight different cutting speeds for the ram. The speed changes in the box are accomplished while the machine is running, by means of seven heat treated steel gears, the teeth of which are machine rounded to facilitate meshing, and two operating levers which are located so the operator can handle them without effort. One of the features of this mechanism is that there is not a loose running part in the whole speed box. Every gear is tight on its shaft. The efficiency of this mechanism is further increased by being arranged to permit running the gears in oil. There are a number of other points in the design such as an improved ram and rocker arm, an automatic and variable cross feed and an automatic safety device, which prevents the breakage of the feed mechanism should the saddle be fed into the rail.

BRONZE JOURNAL BEARINGS.

The American Metal Company, Pittsburgh, Pa., which recently completed a new plant at Wilkinsburg, Pa., has been conducting a number of tests to determine the efficiency of a bronze journal bearing, composed of 65 per cent copper, 30 per cent lead and 5 per cent tin, treated in crucibles. They are solid bronze castings requiring no babbitt surface.

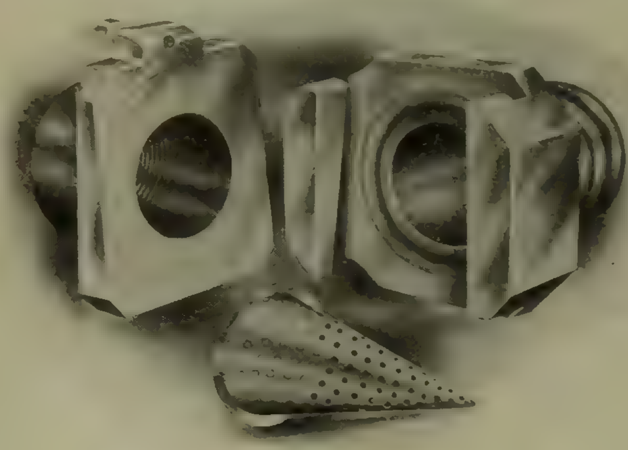
It is said that in a test for the Baltimore and Ohio, a 22 pound bearing was placed under the tender of Pacific type locomotive No. 2127. After the engine had run 51,000 miles, an examination of the bearing was made, it being said that it had worn 1/32 of an inch, without becoming heated at any time. Other bearings on the tender were re-babbitted six times each, according to the shop superintendent in charge of the locomotive.

For mill purposes, this bronze may be hardened into what are claimed to be very superior mill brasses. A test of this nature was made at the Soho works of the Jones and Laughlin Steel Company, Pittsburgh, where two 75 pound mill brasses were used under the rolling table of an 108" plate mill, the minimum weight of which is estimated at 10,000 pounds. The superintendent of the mill stated that the two brasses gave continuous service, for four weeks, or twice as long as the ordinary phosphorous bronze bearing. On account of the position of the bearing, it was impossible to lubricate them during the test. Graphite in the lead acts as lubricant, it is stated, making the metal practically frictionless and reducing the amount of the lubricant required.

The plant of the American Metal Co. is very similar to that of the ordinary brass foundry. Four furnaces of concrete and fire brick construction have been built at one end of the foundry building, 40x90 feet, in which a composition of copper, lead, tin and flux of powdered charcoal is melted. A chain hoist is used to carry the molten metal, by means of a trolley, to the moulding floor at the opposite end of the plant, where the bearings are cast in the usual manner. After the gates have been sawed off, the bearings are polished on an abrasive wheel and then machined on lathes.

TANK HOSE COUPLING.

The American gravity tank hose coupling shown in the accompanying illustration, has been in successful use on forty-two railroads for the past seven years, over fifty-five hundred having been purchased. This design of coupling does away with the expense and annoyance caused by threaded nuts in coupling and uncoupling the water hose connection between engine and tender.



American Gravity Tank Hose Coupling.

It is impossible to connect the parts improperly, and continued vibration brings the parts more closely together.

The coupling is composed of two machined malleable castings, a gasket, strainer and set screw, as shown.

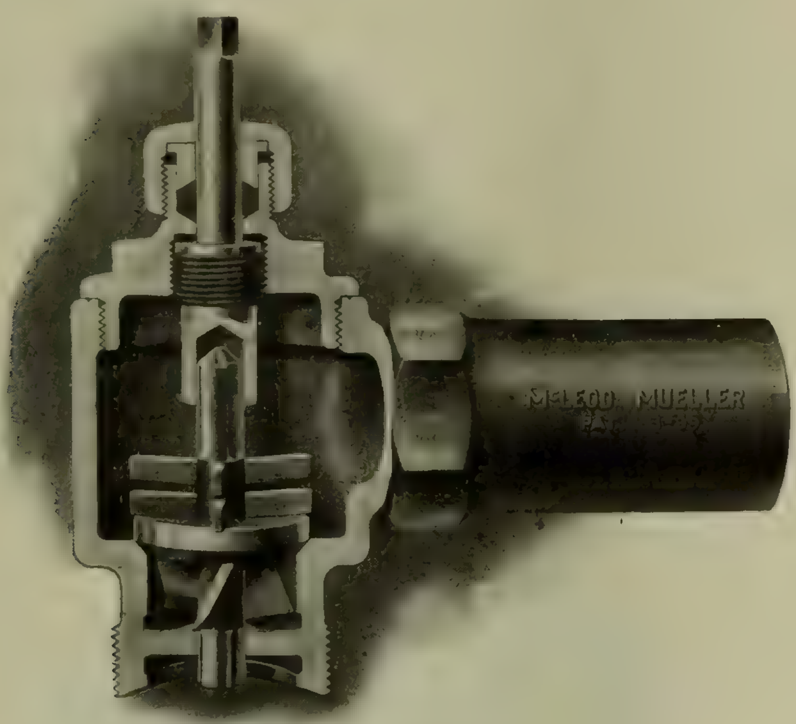
One of the prominent railroads on the Eastern coast has all of its thousand engines equipped, and two roads in the Central West are also completely equipped with this coupling. All engines built for six other prominent lines for the past six years have used this device. It is marketed by Adreon Manufacturing Company of St. Louis.

ROTARY CHECK VALVE FOR LOCOMOTIVES.

A check valve of unusual merit is shown in the accompanying illustration. It is the invention of Norman McLeod, formerly a master mechanic on the Peoria division of the Illinois Central. The H. Mueller Mfg. Co., Decatur, Ill., purchased the patent and has made some improvements in the valve. It is claimed that this valve will not foul, that it will not hang and that it will not

stick; in fact, that it will operate successfully at all times under the most exacting conditions, a claim which seems to have been upheld by the use of the valve on engines in various parts of the country and where water which proved detrimental to other valves was used. The character of the water with which the Illinois Central had to contend was the primary cause of Mr. McLeod designing this valve.

The spindle, upper and lower wings and valve seat are cast in one piece, the water entering on the inlet side striking the turbine wings beneath the valve seat, causing a rotation of the spindle and at the same time lifting the valve and allowing the water to pass on to the boiler. The upper turbine wings, by reason of the constant rotation, keep all sediment in motion and the valve clean. The valve seats with a rotary motion which makes it self-grinding. It can be adjusted from the top so that the flow of water can be lessened or increased as desired. This same principle applied to smaller sized valves has proved very successful on traction engines and threshing engines which have taken their water supply from roadway ditches under the most unfavorable circumstances.



Rotary Check Valve.

The company claims that it has never yet encountered an instance wherein this valve failed to perform its functions. The fact that it does this, regardless of obstacles of muddy or sandy water, without calling for constant replacement, repairs and regrinding, seems to be a very potent argument in its favor.

SELLERS SAFETY SQUIRT.

The illustration shows a new device for operating a squirt hose for coal sprinkling on locomotives, manufactured by William Sellers & Co., Philadelphia.

This device is intended to be set vertically; it can be operated by delivery from the left hand injector or with steam from the boiler. It is connected directly to the strainer or suction pipe with ¾" short nipple, and ½" pipe to the lower end for steam or water pressure; the same size connection to the upper end for the squirt hose.

Water is prevented from entering by means of a heavy check valve. When delivery from the injector or steam is admitted to the bottom of the device it tends to raise the piston which forces outward the water check valve before steam or hot water can pass through the duct leading to the forcing nozzle; the upper part of the chamber in which the piston slides becomes partly closed as the fluted stem of the check rises, producing a dash pot and compelling the piston to rise slowly, giving ample time for the cold water from the suction to flood the device and enter the squirt

Sellers Non-Lifting Safety Squirt.

pipe. The piston then rises, seats on a ground face at the upper end of its travel, admitting full pressure to the forcing nozzle and delivering a strong jet of cool water through the squirt.

When the pressure valve in the cab is closed, the piston drops of its own weight, assisted by the water pressure and spring, draining it completely by the check at the bottom of the device.

This style of squirt is simple; does not require careful adjustment; is easily attached; is self-draining and its delivery cool. It cannot freeze in winter, as it contains no water except the small part over the water check and this is in direct communication with the suction pipe and therefore warmed when steam is blown back in the usual manner.

LOCOMOTIVE BOILER TUBES.

In all branches of mechanical industry, the day of hap-hazard "guess it's good," untested material is long past. Material specified by superintendents of motive power, for instance, must possess a recognized character and have all those special qualities which constitute efficiency in service.

It is no secret that the efficiency of the boiler tube for a long time did not keep pace with the perfecting of the locomotive. The minds of both manufacturer and locomotive builder bent to the task of producing a dependable boiler tube for locomotive service. To this end theories built on past experience, personal bias in favor of material which had been so far satisfactory in the past had all to be thrown into the crucible test of those new conditions engendered by the increasing strain of modern railway requirements.

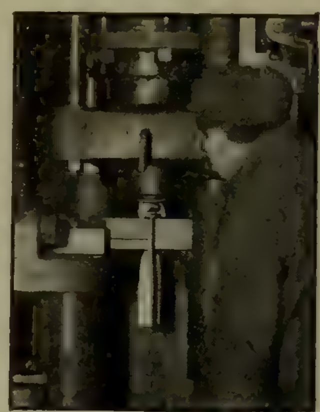
The National Tube Co. had been making charcoal iron tubes for nearly forty years, and manufacturing experiences in the past, with a certain natural bias toward material favored by their customers were the elements making for conservative caution in considering the mild steel (which had already proved successful material for pipe) an equally satisfactory material for boiler tubes—particularly locomotive tubes.

National steel boiler tubes were first carefully made, tested and, after many tests in their own service, offered for the consideration of the railways. Several railways co-operated by arranging closely observed and recorded service tests in locomotive boilers in comparison with charcoal iron tubes.

The manufacturer, through a scientific re-search department, developed a still more uniform and tested material, and finally subjected the lap-weld boiler tubes to a special roll-knobbling process, known as "Spellerizing," to lessen the tendency to corrosion, especially in the form of pitting.

A special test was also devised for Spellerized lap-weld steel boiler tubes, which is illustrated herewith. The test is made on the crop ends, one from each end of every tube and, therefore,

Test of "National" Pipe.



Method of Testing.

each tube which is designed for locomotive service is twice tested by this rigid test.

The crop end is placed in a machine, designed solely for this purpose, and in one operation is given a horizontal flattening, vertical crushing and a flange turned on that end immediately contiguous to the end of the finished tube from which it was cut.

Any tube which fails to stand this rigid test is scrapped. This eliminating test is in addition to the standard tests, consisting of chemical tests, and the physical tests of impact, expansion, crushing and others, to which the tubes are subjected during the various stages of manufacture. These tests begin with the bloom and end with the finished tube.

As a result "National" boiler tubes—both Spellerized lap weld and Shelby seamless steel—are recognized by many railway systems as the boiler tubes which rank in dependable service with the mechanical perfection of the twentieth century locomotive.

HUNT NUT LOCKS, manufactured by Hubbard & Co., Pittsburgh, were placed on the dynamo on the truck of an Illinois Central dining car some two or three months ago, since which time they have remained absolutely tight with no attention whatever. This was a severe test of this nut lock, which was described in the May issue of the *Railway Master Mechanic.*

New Literature

"Ideal Lighting" is the title of a very attractive catalogue just issued by the Central Electric Co., Chicago. It illustrates and describes the Alexalite type of indirect lighting for offices, residences and public buildings.

The Independent Pneumatic Tool Co. of Chicago has published a four-page folder dealing with the new Thor portable electric drill. This is a lightweight drill equipped with a universal motor and equipped with ball and roller bearings.

* * *

The new 1914 catalogue of the Buffalo Brake Beam Co. of New York is a very handsome affair. It contains illustrations and detail drawings of the various types of brake beams and parts manufactured by this concern.

* * *

From the handsome brochure put out by William Jessop & Sons, New York, entitled "A Visit to a Sheffield Steel Works," the following excerpt is taken to show the newer generations how long the Jessop people have been doing business. The firm of William Jessop & Sons was founded in the year 1774 by William Jessop in Sheffield, England. The present works were taken by Thomas Jessop, son of the founder, about 1835, and until the Limited Company was formed in 1876 the business was under his personal supervision, and it was during his management of the works that Jessop's steel became well known on this side of the Atlantic, and it was due to his untiring hustle that the present proud status was inaugurated and maintained. The Brightside works now occupy 60 acres of land, and employ 2,000 of the most skillful steel workers in the world, in the manufacture of crucible and high speed steel, as well as steel castings. Besides this immense plant in Sheffield there are the sheet steel and saw steel works at Washington, Pa.

The Selling Side

E. Silck, vice-president and general manager of the Cambria Steel Co., has been elected a director to fill the vacancy caused by the resignation of E. T. Stotesbury.

Roy C. Munro has resigned as western representative of Wendell & McDuffie, to become connected with the sales department of the Acme Supply Co., with offices in the Steger building, Chicago.

G. H. Dirhold has been appointed advertising and publicity manager for the Walter A. Zelnicker Supply Co., St. Louis, Mo.

The Westinghouse Electric & Mfg. Co. has made the following changes in its sales department. F. N. Kollock, Jr., has resigned his position as district manager of the Seattle office to accept the position of treasurer and assistant secretary of the Westinghouse Lamp Co., Bloomfield, N. J. W. D. McDonald, formerly branch manager of the Minneapolis office, has been appointed to succeed Mr. Kollock as district manager at Seattle. C. C. Curry has been appointed acting branch manager at Minneapolis to succeed Mr. McDonald.

The Chicago Steel Tape Company has established a downtown office at 900 Lytton building, Chicago.

Morgan T. Jones & Co., of Chicago, have incorporated under the name of Morgan T. Jones Company.

The Prince-Groff Company has elected new officers and moved its general offices to 50 Church street, New York. The new officers are Sherman W. Prince, president; George W. Steinmetz, treasurer, and Clarence B. Groff, vice-president. Charles H. Spotts has been appointed sales manager.

William H. Donner, president of the Cambia Steel Co., has been elected also chairman of the board of the Pennsylvania Steel Co.

Theodore Voorhees has been elected president of the Philadelphia & Reading, succeeding the late George F. Baer.

C. P. Williams, formerly with the National Lock Washer Co., has become associated with The Efficiency Company, Railway Exchange, Chicago.

A portable milling machine for refacing valve seats on slide valve engines of locomotives has recently been placed on the market by E. J. Rooksby & Co., of Philadelphia. This firm has added several improvements to its portable boring bars, among them a two speed quick change gear drive, a great improvement where the same boring bar is used on cylinders and valve seats of various diameters. The portable milling machine is of an entirely new and novel design and particularly adapted for deep and solid steam chests, as well as for valve seats with removable steam chests. The machine carries a 3" to 4" end mill, has power feed and does rapid and accurate work requiring little or no scraping. The business of the firm has been growing rapidly and it recently has been found necessary to add to the size of the shop. Additional property has been taken adjoining the present plant which triples the original floor space.

T. B. Bowman, for the past five years assistant to the president and eastern sales manager of the Q & C Company, New York, has severed his connection to become president of The Efficiency Company, with office in the Railway Exchange, Chicago.

The Carter White Lead Works, of West Pullman, Ill., has placed a contract for a factory building, calling for 1,425 tons of structural steel.

The Chicago Concrete Pole Co., operating under the Lienish & Aschaur patents on cruciform section poles, has taken offices in the Railway Supply Permanent Exhibit, ninth floor Lytton building.

The Electric Water Sterilizer Co., of Ccottdale, Pa., is installing an interesting exhibit of its apparatus for the treatment of water by electric process in the Railway Supply Permanent Exhibit. This wil also be their Chicago sales office.

The Murray Packing Co., of Tuscaloose, Ala., makers of packing guards for car journal boxes, has arranged for display space in the Railway Supply Permanent Exhibit, ninth floor Lytton building, Chicago.

The Kennedy-Vanderhoof Co. have moved its office and display room to the Railway Supply Permanent Exhibit, 900 Lytton building, Chicago, where an attractive line of metal suit cases, tool cases, etc., will be on display.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Co., Jersey City, N. J., on April 20, the retiring board of directors and Geo. T. Smith, president; George E. Long, vice-president; J. H. Schermerhorn, treasurer; Harry Dailey, secretary, and Albert Norris, assistant treasurer and assistant secretary, were re-elected.

J. F. Oelerich, who has been associated with the General Railway Supply Co. for the past four years, is now connected with the Transportation Utilities Co., 30 Church street, New York City, with office at 857 People's Gas building, Chicago.

Victor J. Shepard has resigned as chief draftsman of the Lima Locomotive Corporation, Lima, O.

Paul Dickinson, Inc., has moved its office from the Security building to 3346 South Artesian avenue, Chicago, and has discontinued its downtown office.

The Falls Hollow Staybolt Co. has moved its Chicago office from the Old Colony building to 214 Fisher building.

Flint & Chester, Inc., New York, have been appointed eastern selling agent for the National Graphite Lubricator Co., Scranton, Pa.

The Keystone Construction Co., Erie, Pa., will ask a charter of the state of Pennsylvania. The company will manufacture equipment and construct railways, terminals, bridges and buildings.

The Morden Frog & Crossing Works has moved its Chicago office to 1873 Continental and Commercial Bank building, 208 South La Salle street.

L. R. Pomeroy, consulting engineer, has removed his New York office to 16 West Sixty-first street.

The Prendergast Co., Cincinnati, Ohio, has moved its office to 1210 Second National Bank building.

The T. L. Smith Company, of Milwaukee, Wis., has taken over the Chicago Mixer, formerly sold by the Chicago Concrete Machinery Company, Chicago, Ill.

The Paxton & Mitchell Company, of Omaha, have taken space for exhibit and sales offices in the Railway Supply Permanent Exhibit, 900 Lytton Bldg., Chicago.

B. A. Worthington, ex-president of the O. R. & N. Company, and until recently president of the Chicago & Alton, sailed a few months ago for Europe and expects to remain abroad four months. Upon his return he will open an office in Chicago, it is said, for handling railroad investments.

The Phillips Manufacturing Co., of New York, manufacturers of commutator grinders, have opened a western sales office in the Railway Supply Permanent Exhibit, 9th floor, Lytton Bldg., Chicago.

The Welding Materials Company, New York, has moved its New York office from 149 Broadway to 114 Liberty street.

The Stephens Company, railway advertising specialists, have established a branch office in the Railway Supply Permanent Exhibit, 900 Lytton Bldg., Chicago, which will be run in conjunction with the main office in the Great Northern Bldg.

The Union Railway Equipment Company has moved its Chicago offices from 1707 McCormick Building to 624 McCormick Building.

Ed. H. Barnes, Southern representative for S. F. Bowser & Company, Inc., has severed his connections with that company.

Alexander Turner has been elected president of the Bronze Metal Co.

R. J. Davidson has been elected vice president of the Bronze Metal Co.

W. S. Humes, for the past five years sales manager of the General Railway Supply Company, will represent the Transportation Utilities Co., New York hereafter in all of the territory west of Pittsburgh. His office will be in Chicago.

CORRECTION.

In announcing the appointment of H. D. Savage as general eastern sales manager of the American Arch Co., in the April issue of the *Railway Master Mechanic* his date of birth was given as April 16, 1860. This was a typographical error, and should have read April 16, 1880.—Editor.

OBITUARY.

Alexander B. Scully, president of the Scully Steel and Iron Company, died on May 7, at his home at Chicago. He was born in Chicago Nov. 29, 1856, and educated in the public schools in the city. After leaving school he became a messenger boy for the Western Union Telegraph Company. In the year 1875 he entered the employ of Joseph T. Ryerson and remained there until 1885. In 1886 he formed the W. S. Mallory Company, which firm sold out to Joseph T. Ryerson & Son in 1890. In 1891 he formed the Scully-Castle Company, which later became the Scully Steel and Iron Company.

George M. Black, treasurer of the Detroit Seamless Steel Tubes Company and the Monarch Steel Castings Company, and secretary of the Michigan Malleable Iron Company, died at Detroit, Mich., on May 5.

J. Howard Ewald, president of the Pittsburgh Forge & Iron Co., died on May 18.

Leman D. Doty, purchasing agent for the Illinois Steel Company, died on May 24 at his home in Chicago.

Sumner J. Collins, formerly general superintendent of the Southern and recently with the Rail Joint Co., died at Chicago on April 30.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878
Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S. MYERS, Vice-Pres. L. F. WILSON, V. P. & Editorial Director
C. C. ZIMMERMAN, Bus. Mgr. OWEN W. MIDDLETON, Editor
DALTON RISLEY, West. Mgr. KENNETH L. VAN AUKEN, Editor

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: House Bldg., Pittsburgh, Pa.
Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.
This Publication has a larger circulation than any other among mechanical department officers. Of this issue 5,200 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, July, 1914 No. 7

CONTENTS.

State or Federal Control of Railways.

At Shreveport, La., a body of shippers some time ago decided that they were being discriminated against in that rates to Texas centers were higher as charged them than were the rates from Texas cities to these same centers for the same or greater distances. Upon protesting to railway officers it was learned that the lower rates between the points in Texas were probably confiscatory, but nevertheless required by the Texas commission. The result was real discrimination in favor of Texas shippers against those of neighboring states. No doubt the discrimination was intentional on the part of Texas state officials.

When brought to the attention of the Interstate Commerce Commission it was ordered that the railways must cease charging more for the same service inter-state than intra-state. This decision has recently been upheld by the Supreme Court. In the opinion Justice Hughes says: "Wherever inter-state and intra-state transactions are so related that the government of one involves control of the other, it is Congress and not the State that is entitled to prescribe the final and dominant rule."

The wisest statesmen of the country hesitate at the thought of Government ownership of railways, but they see only one alternative and that is viewed with grave doubt. This alternative is the only method short of Government ownership which is yet to be given thorough trial; the exclusive control by the Federal Government over the railways in all their transactions, inter-state or intra-state. Considering this latest decision of the Supreme Court, it would seem that this method would soon be given trial.

It is to be hoped that this trial will be a fair and thorough one, and to gain this end it will be necessary that there be the fullest coöperation between Government and railways for the public welfare and that the commission pay the most impartial regard to railways, shippers, passengers and employes. If this coöperation obtains there should be prosperity for the railways, but if it does not the "skids will be greased" and the railways launched into the waters of Government ownership—a veritable sea of doubt.

July Conventions

During the month of July two important conventions in the railway mechanical field will be held at Chicago—the General Foremen on July 14 to 17, and the Tool Room Foremen on July 20 to 22. It is very fitting that these two associations should meet at the same place, with the one following the other, for they represent the backbone and strength of the shop, and they contain great possibilities for the improvement of the service.

The Master Mechanics and Master Car Builders' associations have not the time to go into the details of shop problems. There are two or three other associations devoted to certain branches of shop operation, but the two above mentioned are the only ones for the handling of general shop problems. The tool room which is giving efficient service is studying the whole shop and the general foreman is necessarily interested in all shop problems.

These two associations have not yet realized their full possibilities, but they are comparatively young and they are forging ahead rapidly. We have always urged that these associations be supported heartily and believe the time is coming when they will be the recognized authority on shop questions. The papers prepared

for this year's meeting are excellent and the shop and tool men who put in their time at the meetings are going to draw good dividends.

Headlight Tests

At the 1913 convention of the American Railway Master Mechanics' Association the committee on headlights stated that it did not feel like making other than a progress report, but that a series of tests was contemplated for the next year if the Association desired. At that time there was much discussion of the report and quite a number wished the Association to take some action as to minimum requirements for headlights at once. However, the committee was directed to go ahead with the tests and action was deferred.

As a result the Association is in the possession of some valuable data on the subject and is in a position to back up any recommendations it may make. The committee which conducted these tests put in a great deal of time on them that they might be complete and conclusive. As stated in its report the investigation took the entire time of about twenty men during the months of July, August, September, October and November of the year 1913, and covered tests on about thirty headlights and two hundred combinations.

An abstract of the committee's report is given in the proceedings of the Association, published elsewhere in this issue. The complete report is a volume of 330 pages, and is really a text-book on the subject. In addition to the very complete tests of the committee, it contains reviews of the findings of other tests. It is notable that the committee's results agree in many respects with those of the tests made by the Wisconsin Railroad Commission and published in the November, 1912, issue of the *Railway Master Mechanic*. The report also contains an outline of the various state laws on the subject, and a motion was very wisely made and carried at the convention that it be published in a separate volume so that it might be used by railway men when appearing before state commissions and other bodies. The Master Mechanics' headlight committee is entitled to the thanks of the entire railway world and the public for its careful and painstaking work.

RAILWAY ECONOMICS IN THE UNITED STATES AND NEW SOUTH WALES.

Three years ago important decisions were given against the railways of the United States, restricting them from raising their rates in order to recoup themselves, as other businesses do, for increased cost of operation owing to the higher cost of labor, materials, etc. Writing at that time, we concluded with the remark, "If the railways may not increase rates, they have a plausible excuse for not allowing, at the present, further increases in wages." In the interval between then and now, however, there have been ordered, as a result of arbitration proceedings, heavy additions to the wages bill in the case of drivers and firemen and train crews. These additional burdens the companies have to bear, though they were decided upon rather with a view to maintaining peace and an uninterrupted service, than because of the strict justice of the demands; in fact, in some cases the pleas were weak and the arguments unsound, while the decisions rendered do not ensure payment in proportion to work done. It is not unnatural that, faced with these facts, the American railways are again appealing for permission to increase their rates.

Here we have in theory recognized, tardily enough it is true, that concessions to the staff cannot go on indefinitely without detriment to the financial situation. Returns fall, borrowing becomes more expensive, and service is reduced. In the United States it is not yet acknowledged that a heavy increase in the wages bill is sufficient ground for an increase of rates. Some time ago it was contended that all that had to be done was to introduce a little "scientific management," when such savings would result that it would be superfluous to talk of raising rates. Today the argument is more subtle. It is allowed that possibly more revenue would be good for the railways, but an endeavor is made to show that it should not be levied on the freight traffic. The argument is somewhat difficult to follow, because, if carried to a conclusion, it could be applied with disastrous effect to many railroad activities. It is now contended that in freight traffic the companies have worked wonders in late years. No mention is today made of inefficiency in this connection; on the contrary, figures are quoted to prove that everything is being done that can be, and that the railways are deriving a fair profit from this form of traffic.

On the other hand, it is pointed out that passenger traffic, in some cases, is carried on without profit. The passenger operating ratio has risen, for instance, on the Pennsylvania Railroad from 74.4 to 92.6 in six years, and on the Baltimore & Ohio Railroad from 82.39 to 106.23 between 1911 and 1913. More costly service has been conceded in face of falling fares, till conditions have been reached which demand reform, as shown by the figures just quoted. According to the annual published by the Bureau of Railway News and Statistics, of Chicago, the average receipts per passenger-mile fell from 2.349 cents in 1888 to 1.928 cents in 1909, since when there has been a slight recovery to about 2 cents. During all this period the railroads have been granting improved services in one form or another. The latest concession, but not the least costly, is the adoption by many lines, in response to popular demand, of steel passenger coaches, which, with their additional first cost, greater weight, and cost of haulage, considerably enhance the working expenses in passenger service. On an average, the steel cars being put into service are costing fully 40 per cent more than the average wooden car. Electric lighting, more elaborate provisions for sanitation, heating and ventilation add now to the cost of service from which no reasonable increase of receipts is obtainable except in the better loading of trains, which on many of the older systems is almost impossible.

On the other hand, with the exception of the more widespread adoption of fast freights, instituted at the request of the trading community, in freight traffic the economies of late years have been very material. The tendency has been the same throughout, but its effects are most clearly seen on such lines as the Hocking Valley, the Bessemer & Lake Erie and the Pittsburg & Lake Erie, on all of which the freight is from 80 to 90 per cent mineral traffic. From answers returned to the Interstate Commerce Commission, it appears that the tons hauled per train on the Pittsburg & Lake Erie have risen from 465 revenue tons in 1893 to 1,225 tons in 1913. In this time the standard 20-ton wooden car has gradually developed into the 60-ton steel car, which means 200 per cent greater earning capacity at only 20 per cent greater maintenance cost. The cost of maintenance of locomotives is said to have increased 100 per cent, and wages 50 per cent, in the two decades, yet the tonnage is handled more cheaply. The following costs are given per 1,000,000 ton-miles, including all train-working expenses, and interest and depreciation on locomotives:—697.18 dols. in 1893 and 453.71 dols. in 1913. In the same time the net earnings per car have risen from 404.02 dols. to 725.23 dols. As a result of the greater capacity of the locomotives and cars, and the rebuilding of the bridges, etc., to meet these changes, there have been heavy increases to face in the form of interest; but the gains in maintenance and wages have more than offset these to the amount of 618,445.69 dols. per annum. These ore-carrying lines have the reputation of having the lowest freight rates in the world, yet the average in the United States for many other forms of traffic is also low. For instance, taken for over 151,000 miles of line, the average receipts per ton-mile of bituminous coal amount to 0.495 cent; for grain the figure is 0.63 cent; lumber, 0.734 cent; and live stock, 1.217 cents.

The appeal has frequently been made by one school in Australia to the use of the 4-ft. 8½-in. gauge in America as proof that such

a gauge is suited to their own country. It would be well, however, for such advocates to learn that for an appeal of this kind to be valid the conditions must be comparable—a fact which has been sometimes, we are almost inclined to believe, wilfully ignored in the somewhat heated atmosphere engendered by the gauge controversy in Australia. At first sight conditions may appear to be similar. In Australia, as in the United States, long-distance traffic forms a large proportion of the whole. In the United States, though figures for special commodities are not available, the average haul in States like Nebraska, Montana and Wyoming is 227 miles, while for all the States the average is 149 miles. With high averages of this character individual commodities must, of course, travel much further. In New South Wales the average for all classes is 75.6 miles, but for grain and flour it is 239.7 miles; general goods in truck-loads, 354.4 miles; wool, 304 miles; ores, 115 miles; hay, etc., 199 miles; and so on. As development in the interior increases the hauls will lengthen, since much of the traffic is to and from the seaboard. Again, in the matter of expenses, Australian railway conditions approach those of America rather than Europe. Wages are higher, materials and plant cost more. Altogether, to be run in a satisfactory manner, with these high and increasing costs, it is clear that in Australia the endeavor should be to foster American conditions. To this end the big-train-load system should be developed. For this the locomotive stock would need to be increased in capacity, as would also the wagon stock, both far beyond existing practice. To bring New South Wales railways up to the American standard would further necessitate improvement in the draw-gear, and, perhaps most important of all, the enlargement of the loading-gauge. The latter features at present limit the character of train-working there in a manner not obtaining in the United States.

The American system has shown that in spite of high costs, low rates are possible if transportation is conducted on the method adopted on that continent. The continental traffic of Australia will have to face higher costs in the future than at present, and it appears that every effort should be made to follow the lead of America, and get away from any resemblance to the expensive conditions of working imposed upon us here. To do so, however, necessitates, as we have pointed out, attention to draw-gear, loading-gauge and other questions. Before these are adequately tackled, no comparison with the United States is of any value except one, that one showing that at present rates are a good deal higher in New South Wales than in America. For what they are worth in comparison with the figures given above for receipts in the United States, we give others for New South Wales, though the only figures available in the latter case are exclusive of terminal charges. The receipts in New South Wales for coal amount to 0.47d (0.94 cent) per ton-mile. For grain they are 0.78 cent; for firewood, 1.6 cents; for livestock, 1.96 cents. For all these the United States rates are lower, and the difference would be increased if the New South Wales figures included terminal charges. Finally, the average for all the United States works out at 0.727 cent per ton-mile, while in New South Wales (exclusive of terminal charges) it is 2.86 cents. The large difference in the latter figures may be due, of course, to a preponderance of high or low-grade traffic in one or the other country, but taken with the others they show that even if labor rose to the United States standard, a good deal ought yet to be possible in Australia, if railway operation is conducted on efficient principles. This is emphasized by the fact that the balance, after paying working expenses, represents in New South Wales about 3.75 per cent on invested capital, whereas in the United States it is about 5.4 per cent. It should be mentioned that the capitalization is, in round figures, 73,000 dols. per mile in the first case, and 63,000 dols. in the second.

In 1912 and 1913 arbitrations in the United States saddled the railways with costs, of which the effect is not yet completely felt, with regard to drivers, firemen and trainmen, while legislation has further burdened them with the "full crew" law, the value of which is very questionable, while it adds heavily to the wages bill.

It is little wonder, under these circumstances, that the ratio of working expenses to revenue rises. At the beginning of this century it fluctuated about 69 per cent. Now it has risen to 73.54 per cent. The influence that wage increase has on this factor will be clear when it is stated that wages form 63.47 per cent of the operating expenses and amount to 44 per cent of the gross revenue. It will be interesting to see if the recent additional expenses due to the demands of labor are taken to warrant some increase of rates, so that the railways may keep up their standard. It is a mistake to suppose that railways, any more than any other trading concern, can meet indefinitely any expense which may be thrust upon them. The effect of whittling down the net revenues by compulsory advances in working cost must, sooner or later, impair their financial stability unless offset in some way, and, if their credit goes, the country they serve must suffer.—*Engineering*, of London, Eng.

Twenty Years Ago This Month

(From the Files.)

What is doubtless the largest mogul locomotive ever built was recently turned out of the shops of the Baldwin Locomotive Works for the Delaware, Susquehanna & Schuylkill. It has 22x26 inch cylinders, 62 inch drivers, a 72 inch boiler and weighs 151,000 lbs. The driving wheel base is 14 feet and the total wheel base of the engine is 22 feet 5 inches. A steam pressure of 160 lbs. is carried. We don't know how much weight is on the truck, but calling it 25,000 lbs., there is 42,000 lbs. on each pair of drivers. Unless there are unusual conditions to be met, this engine is an example of mighty bad designing. One good feature is a six-wheel tender, no trucks.—*Railway Engineering and Mechanics*, July, 1894; Waldo H. Marshall, editor.

The Nathan Mfg. Co., is preparing drawings for the reconstruction of a simple engine on a western road to a compound on the Golsdorf system, the road having ordered one locomotive rebuilt for trial.

Jones & Laughlin, Pittsburgh, have adopted the continuous rolling mill system for rolling bars 1½ in. square, and as the bar comes from the finishing rolls in a length of some 600 feet and at a speed of about 6 feet per second, a flying shear has been adopted which moves with the bar while shearing it, being returned after the cut to its original position.

Chas. T. Porter has brought out a new high speed steam engine in which clearance spaces are reduced to about 2 per cent, and the single piston valve aims to give a steam distribution equal to that of the Corliss engine.

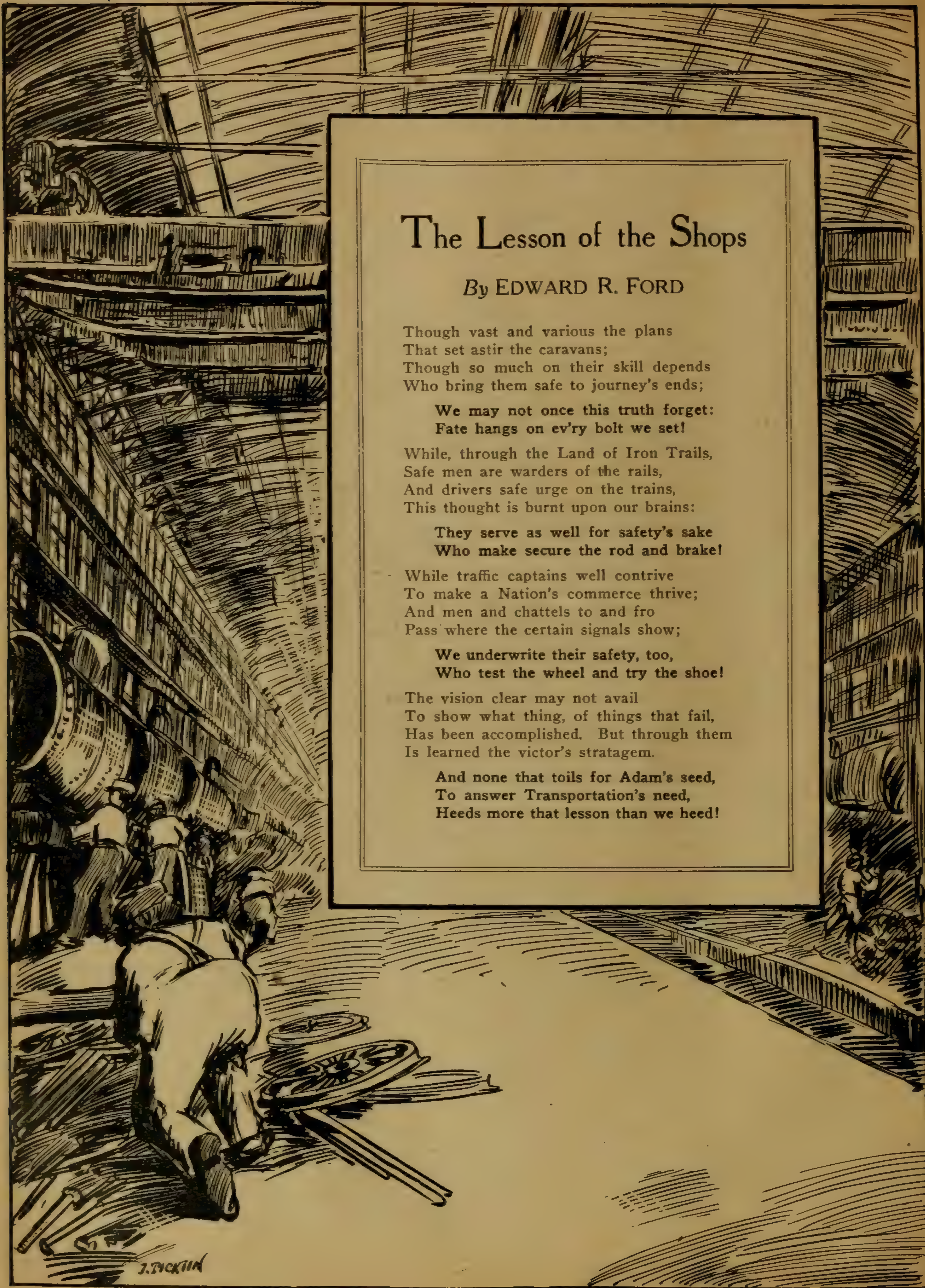
Sporadic orders for cars and locomotives begin to appear—an indication that the dawn of better times is already breaking. The worst of those labor troubles which inevitably precede largely increased production in manufactures is certainly past—and the defeat of the American Railway Union will tend to deter other labor organizations from making unreasonable demands.

The strike of the National Tube Works employees has proved a failure and the works are again running. The usual amount of brutality and lawlessness marked the early days of the strike.

The Boston *Transcript* describes an electric locomotive under construction in Boston, in which electricity is used through the medium of solenoids and armatures placed where the cylinders of the ordinary steam locomotive are located.

F. W. Dean, in discussing compound locomotives for passenger service, claims that with care in designing, a compound should prove as successful in passenger as in freight service.

Engine No. 26 on the Burlington, running between St. Louis and Hannibal, has made a remarkable record in the past two years. It was built in the company's shops at Hannibal and went into service June 23, 1892. It returned to the shops May 20, 1894, being out one year and eleven months, during which time it ran 149,665 miles and was idle only seven days. During this time it hauled the fastest and heaviest passenger trains on the division and no accident of any kind happened to it which caused delay.



The Lesson of the Shops

By EDWARD R. FORD

Though vast and various the plans
That set astir the caravans;
Though so much on their skill depends
Who bring them safe to journey's ends;

We may not once this truth forget:
Fate hangs on ev'ry bolt we set!

While, through the Land of Iron Trails,
Safe men are warders of the rails,
And drivers safe urge on the trains,
This thought is burnt upon our brains:

They serve as well for safety's sake
Who make secure the rod and brake!

While traffic captains well contrive
To make a Nation's commerce thrive;
And men and chattels to and fro
Pass where the certain signals show;

We underwrite their safety, too,
Who test the wheel and try the shoe!

The vision clear may not avail
To show what thing, of things that fail,
Has been accomplished. But through them
Is learned the victor's stratagem.

And none that toils for Adam's seed,
To answer Transportation's need,
Heeds more that lesson than we heed!

Report of the Forty-Eighth Annual Convention of the Master Car Builders' Association

The forty-eighth annual meeting of the Master Car Builders' Association was held on Young's Million Dollar Pier, Atlantic City, N. J., on June 10, 11 and 12, 1914. The convention was called to order by the president, M. K. Barnum, of the Baltimore & Ohio. The president's address followed, extracts from which are given herewith.

ADDRESS OF PRESIDENT BARNUM.

The past year has been probably the most trying on record for railroad managements in the United States, as the narrowing margin between gross earnings and expenses has compelled every official to spend most of his time studying new ways of economizing and reducing expenses without allowing deterioration in the physical condition of the property or in the quality of the service. Working under these adverse circumstances I believe that most of you who are responsible for the equipment have obtained very creditable results, but some of the problems ahead will be more difficult to solve than any yet encountered.

One of the most important and difficult matters confronting us is the proper application and maintenance of safety appliances to conform with the Federal law and with the orders of the Interstate Commerce Commission. The data available indicates that some roads have not been equipping freight cars with safety appliances as rapidly as they must to finish the work within the time limit, or before July 1, 1916, and I wish to impress upon every one the importance of following up this part of the work as vigorously as possible. As there are over 250 different items on a freight car which may constitute a violation of the safety appliance law, it requires careful study to become familiar with them all, and it is very essential that a campaign of education be systematically pursued with car foremen, inspectors and repairmen so that they will know accurately just what the law requires with regard to each part. Every company should have a man on the mechanical department staff specially qualified and trained to follow up safety appliances and to act as the authority on this subject. There should also be at every shop one or more inspectors detailed to instruct and check up those who are employed in applying and repairing safety appliances.

Too much emphasis cannot be placed on the importance of maintaining correctly all details of cars which have once been fully equipped with safety appliances, and in making partial repairs to cars which have not been equipped, it is good practice to make the same in accordance with the law which must ultimately be complied with in full. In cases of doubt as to the exact interpretation of the law it will usually prove a safe guide if we consider why it was made and what was its intent.

Another important matter to be considered is the adding of a sufficient percentage of the labor shown on bills for car repairs to fully cover all overhead expenses, including upkeep of the plant, taxes, insurance, etc. Companies which build and repair cars usually add from 65 per cent to 80 per cent for overhead expenses and there is reason to believe that railroads may be expected in the future to handle such matters on a manufacturing basis.

The large number of suggestions for changes in the rules of interchange each year seem to indicate a necessity for their yearly revision, but after the revision proposed for 1915, it may be well to try them for two years without change.

Some members have recommended eliminating all the rules covering combinations of defects which are supposed to indicate unfair usage, viz.: rules 37 to 43 inclusive. Some of the arguments for doing this are that the present rules tend to penalize those companies which build strong cars and to unduly favor those having weak cars, also that no satisfactory basis has been found for combinations in all-steel and steel underframe cars. While conceding these points the Arbitration Committee has not thought that the time was ripe for the elimination of all combinations.

On account of numerous questions received by the Secretary the Arbitration Committee has sent out to the members interpretations of those rules which are not clearly understood and it may be well to have a formal expression from the members as to continuing the issuing of such interpretations.

Many freight cars originally of wood construction are being practically rebuilt and strengthened with steel underframes, friction draft gear, steel ends, new roofs, new siding, etc., so that they are stronger and better than when first built and their ultimate life will be prolonged probably fifteen or twenty years. These improvements usually cost from $250.00 to $400.00 per car, a part of which is properly chargeable to capital account, and it seems only fair that some allowance should be made for them in figuring the depreciation when such cars are destroyed and that those companies which are spending such large amounts to strengthen their cars should not be penalized for so doing, as at present. This subject is of sufficient importance to justify appointing a special committee to study and report upon it at the next convention.

It would also be a great benefit if standards could be adopted for the principal dimensions of 40-ft. and 50-ft. freight cars. Some years ago the American Railway Association decided upon a standard 36-ft. box car, but almost immediately the traffic departments began to ask for a variety of different sizes, and today very few roads build the standard 36-ft. car. The committee on retirement of 40,000 to 50,000 pounds capacity freight cars has presented a definite recommendation which will help to improve the situation if adopted, and it will undoubtedly bring out a full discussion.

There should be more standards for passenger car parts and these need not specify all details, but should cover those features which affect interchangeability.

The building of new wooden passenger cars was practically stopped a year or more ago and most roads are applying steel underframes and ends to the older cars as fast as money can be obtained for the work, with the result that there are now 3,566 less wooden passenger cars in service than there were two years ago, so with the general use of steam heat and electric lights passenger travel on steam railroads is steadily growing safer. The fact that in 1912 the number of passengers killed in train accidents was only one for each 251,000,000 passenger miles, has enabled insurance companies to pay double and triple indemnities for such accidents, and, as stated before, the conditions are steadily improving.

SECRETARY'S AND TREASURER'S REPORT.

The secretary's report showed that the association had a total of 891 members, classified as follows: Active 422, representative 436, associate 13, life 20. The treasurer's report showed a balance on hand of $627.91. The secretary stated that the executive committee recommended that the dues of representative members be increased to $7, while the dues of active and associate members were to remain as at present. A motion was made that the association adopt the recommendations of the executive committee. It was carried.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

The committee submitted the following report:

JOURNAL BOX AND DETAILS—STANDARD.

Page 826. Sheet M. C. B. 2.

A member calls attention to the note to the left-hand side of the plan of journal box, suggesting that same be eliminated, and the drawing corrected to show the 7⅝-in. dimension over all, as per Plate 3-B, Proceedings, 1891. The committee concurs and secretary is instructed to correct.

JOURNAL-BEARING WEDGE—STANDARD.

Pages 826-829.

For Journals, 5 by 9 in. Sheets M. C. B. 7 and 9.
For Journals, 5½ by 10 in. Sheets M. C. B. 10 and 12.
For Journals, 6 by 11 in. Sheets M. C. B.—A and A-2.

A member calls attention that above wedges should be shown with downward projecting lips at the front of the wedge, similar to the wedge shown on sheet 6 for the 4¼ by 8 in. journal. The committee concurs and secretary is instructed to have drawings corrected.

LIMIT GAUGE FOR REMOUNTING CAST-IRON WHEELS—STANDARD.

Page 841. Sheet M. C. B. 16-A.

A member calls attention that the letter "G" should be added at top of flange on the diagram covering the application of limit gage to secondhand wheels with high flanges. The committee concurs and secretary is instructed to have this done.

SAFETY APPLIANCES—FREIGHT-TRAIN CARS—STANDARD.

Pages 908-935. Sheets M. C. B. 19 and 19-A to 19-P.

A member calls attention to the brake chains as shown on Federal Plate A. M. C. B. sheets 19-A and 23-A, and suggests that Plate 19-A be again revised, omitting the dimensions, showing the length of the link, and the words "⅞-in. minimum and ½ in. preferable" should be added to denote the size of material of the enlarged link. The committee does not concur in this recommendation, but does recommend that on sheet 19-A the word "preferable" be omitted opposite the dimension "⅞ in.," and also "⅜-in minimum" be omitted for brake chain, which will make this correspond with the brake chain, as shown on sheet M. C. B. 23-A, from which the brake chain can be omitted, the secretary being instructed to change accordingly.

UNCOUPLING ARRANGEMENTS FOR M. C. B. COUPLERS—RECOMMENDED PRACTICE.

Pages 954-955. Sheet M. C. B. 19-B.

A member calls attention to second paragraph, which reads that uncoupling arrangements were made to conform to requirements of United States Safety Appliance Act, as shown on sheets 19-A and 19-B. The reference to sheet 19-A should be omitted, as this pertains only to the brake mast and brake chain. The committee agrees and secretary is instructed to correct.

AUTOMATIC COUPLER YOKE—STANDARD.

Page 942. Sheet M. C. B. 23-A.

A member suggests that the rear of coupler yoke be changed to be formed with ⅞ in. radius at inside corners and fitted with 1 in. filler block, wrought iron or steel, having 1-in. radius ends, the same to be riveted to back end of pocket with 1¾-in. countersunk rivet. The committee concurs in this recommendation.

SIGNAL-LAMP SOCKET—STANDARD.

Page 956. Sheet M. C. B. 26.

A representative of the American Car & Foundry Company calls attention that this is shown as having a total length of 3⅞ in., while this is indicated in 1910 Proceedings, Sheet B, with over-all length of 3⅝ in. The committee acknowledges the error and instructs the secretary to make necessary correction.

SIGNAL-LAMP SOCKET—STANDARD.

Page 956. Sheet M. C. B. 26.

Referring the action of the 1912 and 1913 conventions, in regard to standard location, after fully considering same, the committee recommends that this be 9 ft. 6 in. approximately from top of rail to bottom of slot, and so located that the axis of the socket is 45 deg. with center line of car. This in view of the clearances of railroads. size of markers and lens, etc., which are at such variances that it is not practicable to establish a fixed location transversely.

BOX-CAR SIDE-DOOR FIXTURES—STANDARD.

Page 1060. Sheets M. C. B. 30 and 30-A.

A member submits a plan showing outside door arrangements to take the place of the outside door, as at present shown, calling attention that this is incomplete in details, particularly as to top hanger and door track. The committee refers this to the committee on car construction.

UNCOUPLING ARRANGEMENTS FOR M. C. B. COUPLERS—STANDARD.

Pages 954-955. Sheets M. C. B. 23-A.

A member calls attention to the two links shown separate from the uncoupling attachment; should be 6¼ and 2¼ in. in length instead of 6½ and 2¾ in. The committee agrees and secretary is instructed to correct.

JOURNAL BOX AND DETAILS—RECOMMENDED PRACTICE.

Page 829. Sheet M. C. B.—A-2.

A member recommends that the journal-box lid key for 6 by 11 in. box be the same as for the 5½ by 10 in. The committee concurs in this recommendation.

Page 829. Sheets M. C. B.—A, A-1 and A-2.

A member suggests that journal box, bearing, wedge and lid for 6 by 11 in. journal be advanced to standard. The committee concurs in the recommendation.

JOURNAL BEARING AND WEDGE GAGES—RECOMMENDED PRACTICE.

Page 830. Sheet M. C. B.—A-3.

A member suggests that journal bearing and wedge gages, also dust guard for 6 by 11 in. journal, be advanced to standard. The committee concurs in the recommendation.

END FOR HOPPER-DOOR OPERATING SHAFT—RECOMMENDED PRACTICE.

Page 967. Sheet M. C. B.—F.

A member suggests that this be advanced to standard. The committee concurs in this recommendation.

STEAM AND AIR CONNECTION FOR PASSENGER CARS—RECOMMENDED PRACTICE.

Page 1056. Sheet M. C. B.—Q.

A member suggests that the 20-in. dimension between center of steam pipe and center of air signal on the cut showing steam and air connection should be underlined, as per previous practice. The committee agrees and secretary is instructed to correct.

AIR-BRAKE APPLIANCES—RECOMMENDED PRACTICE.

Pages 898-899. Sheet M. C. B.—Q.

A member suggests that size of cylinders and style of triple valves, adopted as recommended practice in 1913, be advanced to standard. The committee concurs in this recommendation for all cars built after January 1, 1915, for 10-in. air-brake cylinders for freight cars weighing between 37,000 lb. and 58,000 lb. light weight, and triples K-1 for 8-in. and K-2 for 10-in. equipment.

LOCATION OF LABEL ON AIR-BRAKE HOSE—RECOMMENDED PRACTICE.

Sheet M. C. B.—Q.

A member suggests that the position of the bolting lugs of air-brake hose at coupling and at nipple end, also location of air-brake hose label, be advanced to standard. The committee concurs in this recommendation.

DIAMETER OF STEEL AND STEEL-TIRED WHEELS—RECOMMENDED PRACTICE.

Page 846.

A member suggests that the diameter of steel and steel-tired wheels be advanced to standard. The committee concurs in this recommendation for 33-in., 36-in. and 38-in. diameters.

NEW SUBJECT.

A member calls attention to the index of the M. C. B. Proceedings, suggesting that it requires thorough revision and that the subject should be taken in hand and arrange to prepare a more suitable index. The committee concurs and secretary is instructed to do this, which will require a more elaborate index.

Committee: T. H. Goodnow (chairman), W. H. V. Rosing, C. E. Fuller, T. M. Ramsdell, O. C. Cromwell, O. J. Parks, F. F. Gaines.

Discussion.

T. H. Goodnow: Attention has been called to the steam hose label in the Proceedings of last year, which included the word "copyrighted" on the label. No action has been taken to copyright the label.

Secretary Taylor: A prominent patent attorney advises that as an association we cannot get a copyright, but we can get a trademark. Application for trademark is on file in the Patent Office now.

E. W. Pratt: I move that when the trademark is obtained the Association grant to manufacturers the authority to apply it to steam hose meeting its specifications.

The motion was carried.

C. E. Fuller: I move that in the recommendation referring to center plates, the clearance between the body and truck center plates be increased to ¼ in., and that the matter be submitted to letter ballot.

R. L. Kline: I amend Mr. Fuller's motion by referring the question to the committee on car trucks.

The motion as amended was carried.

C. E. Fuller: I do not see any necessity for stenciling the weight on the end of the car, and I move that it be eliminated.

E. W. Pratt: I amend the motion by giving the executive committee the authority to present the matter to the American Railway Association.

J. J. Tatum: Omit the weight on the end of the car because of "Safety First," if for no other reason.

Mr. Fuller's motion was carried as amended.

T. H. Clark: I move that the report of the committee, as amended, be approved and referred to the Association by letter ballot.

This motion was carried.

TRAIN BRAKE AND SIGNAL EQUIPMENT.

The committee believes that all passenger equipment cars should be equipped with brake and signal pipe end clamp hangers of a swinging or sliding design, so that sufficient lateral motion will be provided for the ends to prevent pulling apart of hose couplings.

The conductor's valve being an important emergency device, due consideration was given to the merits of various types of these valves with a view to selecting for adoption that which appeared to possess the greater merit, the type selected, known as the B-3-A, the committee recommends. It is of the check valve type, rubber seated, and is not self-closing.

Whenever permissible in passenger carrying cars, the committee recommends that conductor's valves be corded the entire length. Where this cannot be done, as is generally the case in dining, buffet, and certain classes of load carrying cars, the committee recommends that two conductor's valves be installed, one at each end of the car, and that each be corded into the car a distance necessary, including platforms, to permit of easy access.

To prevent delay or confusion in getting hold of the right cord to operate the conductor's and signal valves, the committee recommends that the conductor's valve cord be of red and the signal-valve cord be of gray color; also, that the cords be made of metallic material; that is, either of wire or of chain, the committee's preference being chain for the conductor's valve and hemp or cotton covered wire for the signal valve.

The committee desires to keep before the association the class type of truck-brake rigging for passenger-equipment cars on account of the superior merits and higher degree of efficiency of this type, and because it is apparent that the single-shoe type of truck-brake gear does not come up to requirements on modern steel-car equipment. The committee recommends that a special committee be appointed to make investigations with a view to making a general determination of the relative merits of different designs of clasp brakes. Also that this committee make investigations with a view of finding a more satisfactory design of hand-brake rigging.

On account of the limited range of action of the present train air-signal, the committee desired to bring to the association's attention the need of an improved train signal, with a view of accelerating the development of a signal device which shall be entirely satisfactory in its operation, such signal to permit of easy and prompt communication both between the train crew and engineman, and the engineman and train crew, under all conditions of service.

The advantages derived from the use of galvanized pipe on coal and refrigerator cars are so large in the way of economy of maintenance and of satisfactory brake operation that the committee respectfully begs to call once more the attention of the association to the desirability of using this kind of pipe on cars of the classes named.

AIR BRAKE AND TRAIN AIR SIGNAL INSTRUCTIONS.

That portion of the Master Car Builders' and American Railway Master Mechanics' Association Air Brake and Train Air Signal Instructions under the heading of "General Instructions" has been revised by the committee, and the revision is incorporated in this report.

That portion comprising the "General Questions and Answers" has not been dealt with for the reason that the number of different types of brake equipments now in use is so large, and the fact that local conditions of different roads require special modifications in methods of handling brakes, therefore it would be practically impossible to formulate a series of questions and answers that would be universally applicable. Moreover, the Air Brake Association has formulated a series of questions and answers that supplies all the air-brake information required in that form. The committee further recommends that a committee from this association and from the Master Mechanics' Association be appointed to confer with the Air Brake Association committee having this matter in hand.

Committee: R. B. Kendig (chairman), B. P. Flory, R. K. Reading,

R. B. Rasbridge, L. P. Streeter, A. J. Cota, and W. J. Hartman.

Discussion.

W. E. Dunham: An attempt to keep up these questions and answers every year is impractical, and I move that the "Questions and Answers" be eliminated from our standards, but that a special committee be appointed to follow it up.

This motion was carried.

W. E. Dunham: I move that the suggestion regarding the adjustable pipe clamps, clasp brakes, the hand brake rigging, and train signal system be referred back to this committee for further investigation.

The motion was carried.

C. E. Chambers: I move that the wording "including platforms" be omitted in paragraph 3.

The motion was carried.

C. D. Young: I move that the report of the committee as amended be submitted to the association by letter ballot.

The motion was carried.

BRAKE SHOE AND BRAKE BEAM EQUIPMENT.

The committee has considered two sets of problems, those relating to the behavior of brake shoes and those affecting the design of brake beams.

BRAKE SHOES.

According to instructions, the committee has completed the tests on brake shoes, supplementing the work of previous years and closing up the gap which has heretofore existed between the earlier tests and those made at high pressures and speeds. As far as possible, the tests this year employed the same shoes as used in the last series of tests, or duplicates. It is believed that this finishes the tests necessary for a complete understanding of the effect of various pressures and speeds on the coefficient of friction and wear of various types of brake shoes.

The following is from the report of Prof. L. E. Endsley, who personally conducted the tests upon the shoes:

Each shoe was tested upon a steel-tired wheel under the following brake-shoe pressures: 12,000, 14,000, 16,000 and 18,000 lb., the initial speed of the machine being in each case 65 miles per hour. At each of the above pressures nine stops were made.

In anticipation of a test, the shoe was given a number of applications until a full bearing surface was obtained, after which it was accurately weighed upon a pair of scales. The shoes were first tested at a pressure of 12,000 lb., after which the pressure was increased by increments of 2,000 lb. until a pressure of 18,000 lb. was reached, or until the shoe broke or became unserviceable.

The loss in weight of the shoe was obtained by weighing the shoe after each three applications, thus giving a check upon the loss for each pressure.

Between each application the shoe was cooled by a blast of air until the temperature was reduced to such an extent that the observer could bear his hand upon the shoe.

The results obtained are given in Figs. 1, 2 and 3.

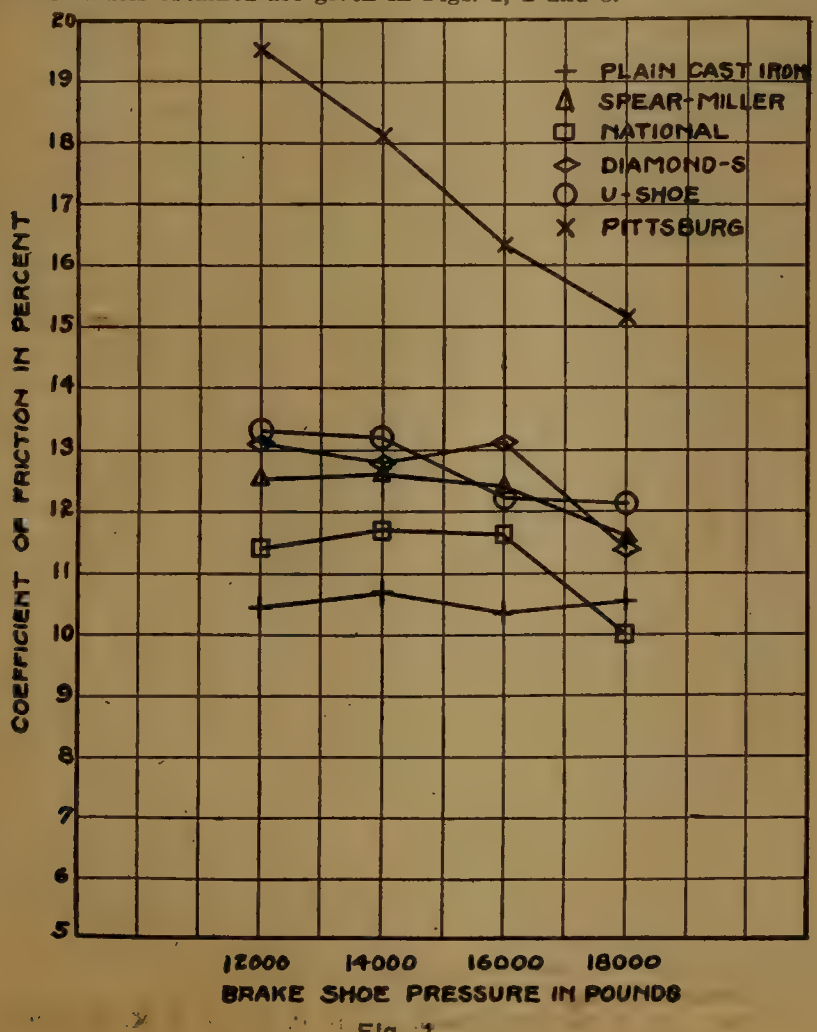


Fig. 1.

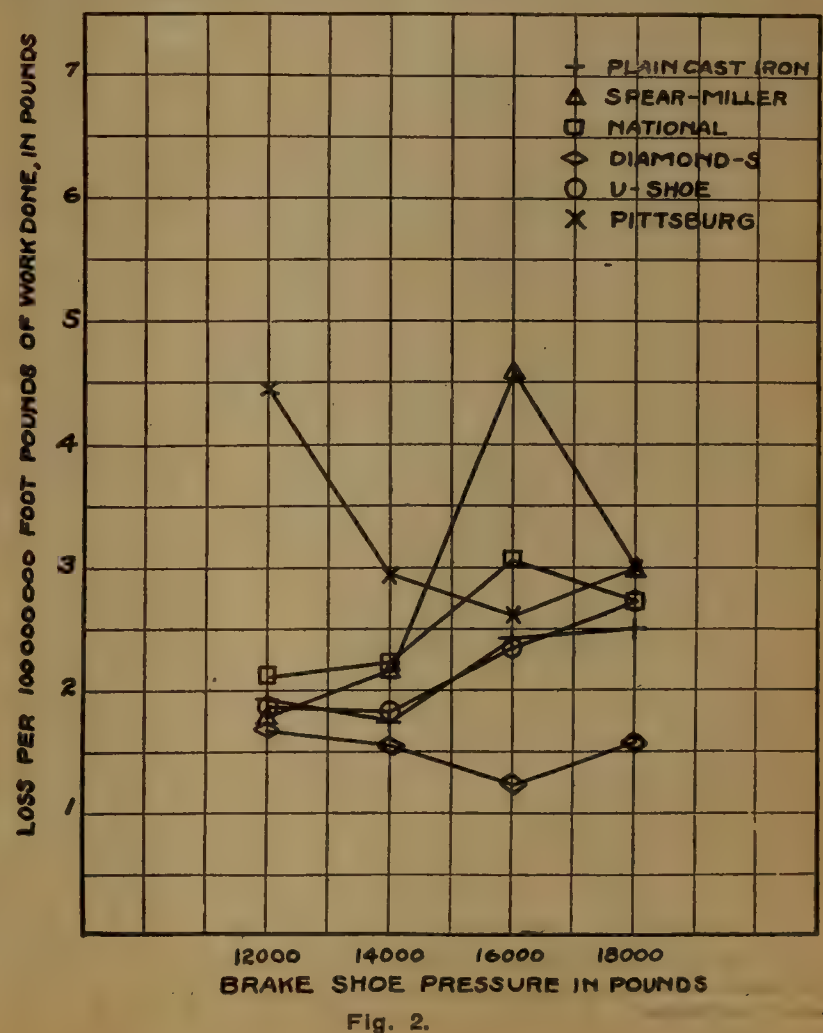


Fig. 2.

Fig. 1 gives the average coefficient of friction of each kind of shoe tested, plotted against the brake-shoe pressure.

Fig. 2 gives the average loss per 100,000,000 foot-pounds of work done for each kind of shoe, plotted against the brake-shoe pressure.

Fig. 3 gives the approximate distance per stop in feet for each kind of shoe, plotted against the brake-shoe pressure.

It will be seen from Fig. 1 that the coefficient of friction of most of the shoes decreased as the pressure increased, the two exceptions to this being the plain cast iron and the National. The plain cast-iron shoe gave almost the same coefficient at all pressures, while the National gave almost the same coefficient at the three lower pressures and then made a sudden drop at 18,000 lb. pressure.

The loss in weight, due to wear, as plotted in Fig. 2, shows that in the case of four of the different types of shoe tested, the loss increased as the pressure increased up to 16,000 lb. With two of the kinds of shoes tested, the loss reduced at 18,000 lb. pressure. This seemingly inconsistent result may be accounted for by the fact that two of the shoes, namely, the National and the Spear-Miller, broke during the tests at 16,000 lb., thereby increasing the wear for a time at least, and possibly decreasing the wear when the broken shoes had again been worn to a new fit before the 18,000 lb. pressure.

Two of the types of shoes tested, namely, the Diamond S and the Pittsburg, showed a tendency to reduce the wear as the pressure was increased up to 16,000 lb., but increased at 18,000 lb. pressure. No doubt this reduction in loss was due to a change in the per cent of insert in contact or a change in the physical makeup of the shoe.

It will be seen from a study of Fig. 1 that the coefficients of friction of five of the different types of shoes tested fall somewhat close together, but not nearly so close as they did in the tests conducted at 80 miles per hour and reported in 1911. In 1911 the variation was less than 2 in the value of the coefficient of friction in per cent at any pressure for all shoes tested, with the exception of the Pittsburg shoe. From the results reported this year at 65 miles per hour, it will be seen that this variation is considerably more, being as much as three or over at the different pressures. The coefficient of friction in 1911 was never over 10 per cent nor under 7 per cent, an average for all shoes with the exception of the Pittsburg, being approximately 8.4, while in the tests this year at 65 miles per hour, the maximum was 13.3 and the minimum 10 per cent for all but the Pittsburg shoe. The average coefficient of friction at 65 miles per hour was 12.2, thus making it greater by 3.8 than it was at 80 miles an hour.

The Pittsburg shoe in the tests of 1911 at 80 miles an hour varied in a straight line from 19.75 per cent at 12,000 lb. pressure to 17.1 per cent at 18,000 lb. pressure. It will be seen from the tests made this year that the coefficient of friction of this shoe was less at 65 miles an hour than at 80 miles an hour. It will also be noted that the loss of weight in the Pittsburg shoe was more at 65 miles an hour than at 80 miles an hour. In 1911 the average loss at 80 miles an hour was 2.8, while this year the results at 65 miles an hour showed a loss of 3.2. This apparent inconsistency in the coefficient of friction and loss in wear of the Pittsburg shoe may be accounted for by the fact that the

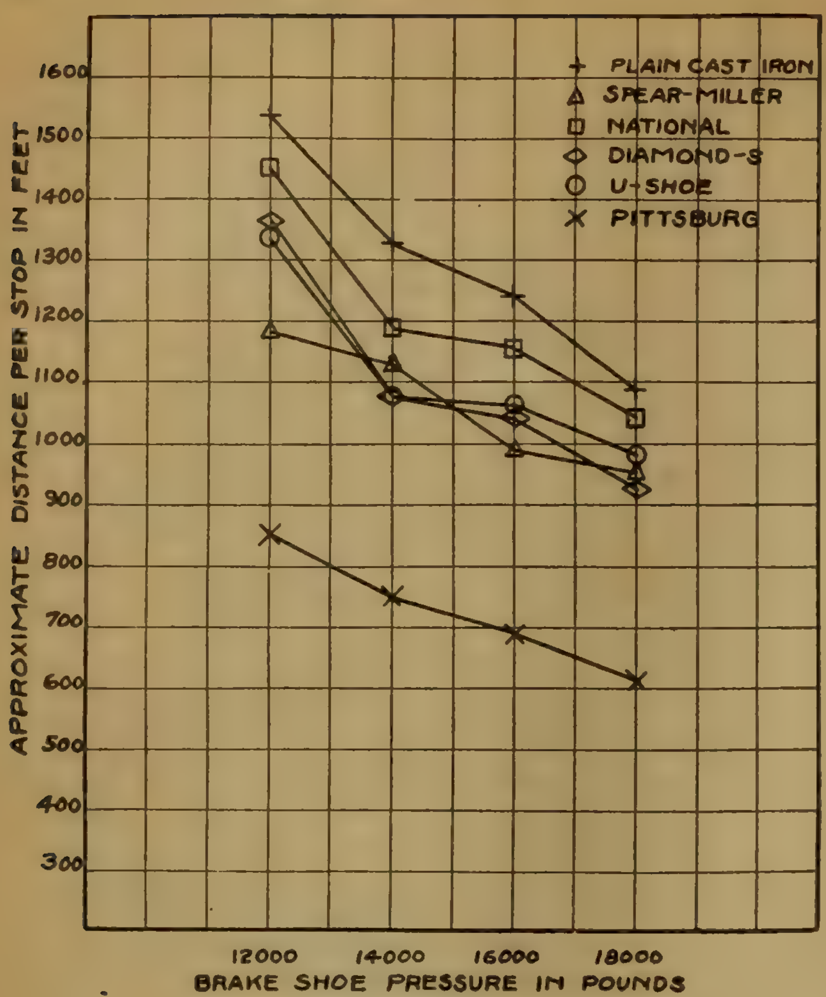


Fig. 3.

shoe is made of a composition filler, and as the shoes have been lying in the laboratory for three years where the temperature was 70 deg. or more, the binder which holds the filler together may have dried out, thus reducing the coefficient of friction and increasing the wear.

The results given in Fig. 3 show that the approximate distance per stop was inversely proportional to the coefficient of friction, all of the metallic shoes varying about the same as for coefficient of friction, and this variation is greater at 65 miles per hour than at 80 miles per hour, as reported in 1911. The Pittsburg shoe made stops at approximately half of the distance required by the poorest metallic shoe.

The committee would suggest the desirability of having a complete review and digest of tests so far made, with suitable conclusions, to be made a part of the next year's proceedings. There has not been time to prepare such a digest this year.

BRAKE BEAMS.

The committee recommends that the following be substituted for the specifications for No. 2 brake beams, as given in the M. C. B. Proceedings for 1913, page 854:

Apply an initial load of 12,000 lb., then reduce to 500 lb. Reset the deflection instrument to zero.

Apply a test load of 12,000 lb. and under this load measure the deflection, which is desired to be $\frac{1}{16}$ in. or 0.0625, but should not exceed 0.07 in.

The beam must then be loaded to 24,000 lb., after which the set shall not exceed 1-100 of an in.

The brake beam shall stand a total motion of the head of the machine of not less than 2 in. without failure at any point.

This change is recommended because it is more in accordance with engineering practice to determine the strength and stiffness of structures at or below the elastic limit rather than to determine the load which will produce actual failure or destruction, it being understood that no part or structure will safely withstand repeated stresses above the elastic limit.

The committee has considered the desirability of adding to these specifications a limitation as to the minimum weight of heads and struts allowable and has collected considerable information concerning the weights of these parts now in use. Communications from the various manufacturers of brake beams show a considerable variation in weights of struts and heads, due largely to variation in design.

The committee believes that some specification which shall define the strength of these two important members should be added to the other specifications, but that specifying a minimum weight would not be sufficiently definite. The committee would like the benefit of further discussion on this point.

In view of the results of a preliminary vote, the committee would recommend that Beam No. 2, shown in Sheet 17-B, be adopted as Recommended Practice, and would ask that the question be again submitted to letter ballot. The committee would justify its recommendation by calling attention to the decided majority in favor of this step and to the further fact that adopting a standard of this kind as Recommended Practice for a few years will give the Association and the committee something definite to build upon in forming a standard for brake beams which shall be acceptable to all members of the Association.

Figures, accompanied by photographs, submitted by C. D. Young of the committee, show that about 75 per cent of the defective brake beams found on the Pennsylvania were removed on account of worn brake heads, indicating that if beams were properly hung and the locations for hanger holes and hanger brackets were standardized, a large number of failures could be prevented. Failure of the compression and tension members is further shown to be due largely to poor fits between the heads and struts and the other members. In other words, it is apparent that a more careful standardization of brake beams would result in a much smaller percentage of failures and much less expense to the railway companies.

Committee: PROF. C. H. BENJAMIN (Chairman), C. D. YOUNG, R. B. KENDIG, J. F. DE VOY, C. B. YOUNG.

Discussion.

F. W. Brazer: I move that the report on brake shoes be accepted, and the recommendation carried out.

This motion was carried.

The report on brake beams was accepted and referred to letter ballot.

CAR WHEELS.

The following resolution of the committee on maintenance of the American Railway Association, which was referred to the Master Car Builders' Association and the American Railway Engineering Association for investigation and report, has been referred to the wheel committee and the committee on track, respectively, of the two Associations:

"Resolved, That the subject of the contour of chilled car wheels and the throat clearances for frogs, guard rails and crossings be referred to the American Railway Engineering Association and the Master Car Builders' Association jointly for a full investigation and report with their recommendations for any change that they may conclude is desirable."

This subject originated with the Association of Manufacturers of Chilled Car Wheels, and your committee has received a number of recommendations from the wheel manufacturers in the direction of heavier flanges.

There is not sufficient available data showing the performance of the latest design of chilled wheel, or comparison of its performance with the earlier designs to warrant the committee at the present time making any recommendations in the matter. To increase to any extent the width of flange will involve in all probability changes in the track in the way of providing more clearance through frogs, guard rails and railroad crossings.

The Bureau of Standards of the Department of Commerce, Washington, D. C., is preparing to make an experimental study of chilled car wheels, which will include foundry practice, investigation into the chemistry, metallurgy and mechanics of wheels, etc., and we are informed that it is the intention of the Bureau of Standards to ask the co-operation of the wheel manufacturers and the wheel users in making this investigation.

In order to provide means for measuring flat spots of one inch and two inches in length on passenger and freight car wheels respectively, it is recommended that two additional notches be provided in the present standard wheel defect gage, as shown in Fig. 1.

The committee calls attention to some errors that were made by the special committee which revised the specifications for wheels in 1913. It was the intention that these specifications were to be revised in form only and not in meaning; however, as these revised specifications were referred to letter ballot and adopted, it becomes necessary to bring the corrections before the Association. Under the heading "Markings," Paragraph 14, it is specified that the name of the purchaser, wheel

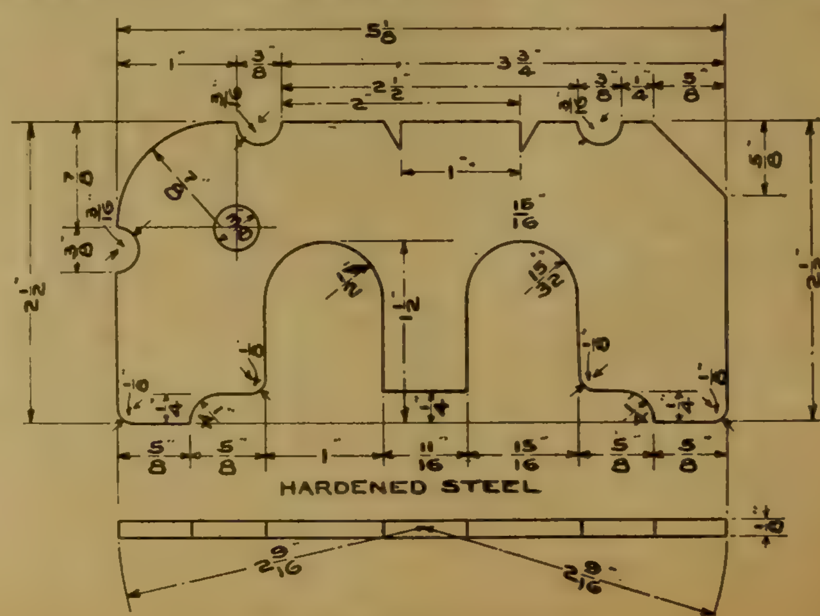


Fig. 1—Wheel Defect Gauge.

number, weight of the wheel, and date made, etc., be plainly formed on the outside plate of the casting. This should be corrected by substituting for the word "Outside" the word "Inside," which is in accordance with previous practice.

The following recommendations are submitted:

Wheel defect and worn coupler gage to be modified as shown in Fig. 1.

Specifications for cast-iron wheels, Paragraph 14, change first sentence to read as follows: "All wheels shall be numbered consecutively in accordance with the instructions from the railroad company purchasing them, and shall have the initials of such railroad company,

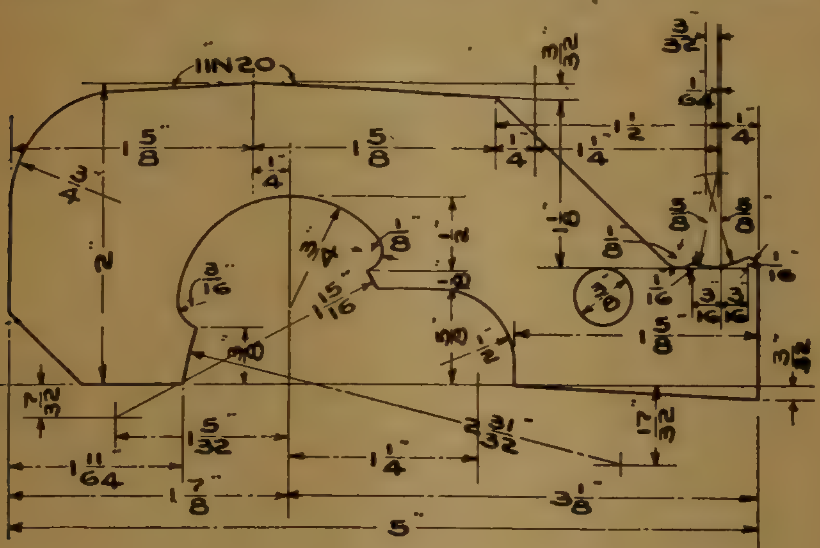


Fig. 2.

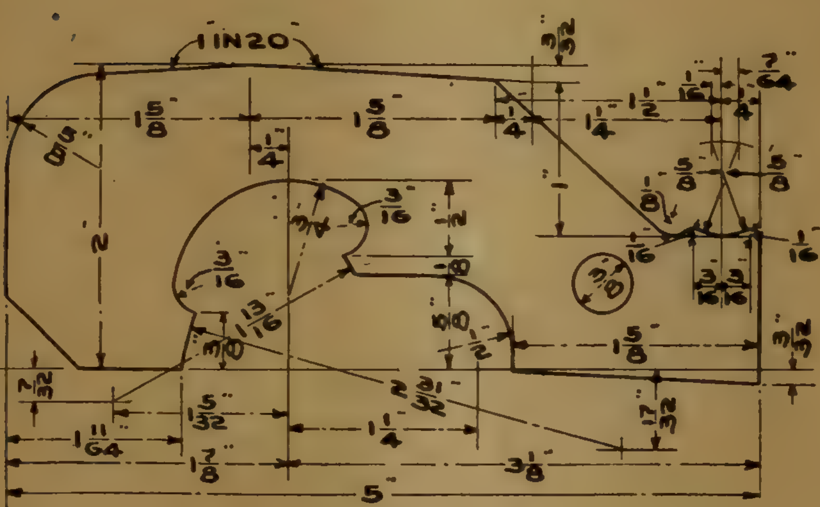


Fig. 3.

also the wheel number, the weight of the wheel and month, day and year when made, plainly formed on the inside plate of casting."

Specifications for cast-iron wheels, Paragraph 4 (b), change last sentence to read: "The time when pouring ceases must be noted and two minutes later an examination of the wheel must be made. If the wheel is found broken in pieces, or if any cracks in the plate extend through or into the tread, all wheels of the same tape size as the wheel broken will be rejected."

Specifications for solid wrought steel wheels, Paragraph IV, Branding, to read: "The name or brand of the manufacturer, date and serial number, shall be legibly stamped on each wheel; also purchaser's name and serial number, if specified. The tape size shall be legibly marked on each wheel. Sheet M. C. B. C-2."

Correct M. C. B. Sheet "N" to specify maximum gross weight not to exceed 95,000 lb.

Three diameters of steel tired wheels: 33, 36 and 38 in.

Three diameters of centers for steel tired wheels: 28, 31 and 33 in.

Maximum and minimum flange thickness gages to be as shown in Fig. 2.

Committee: W. C. A. Henry (Chairman), A. E. Manchester, R. W. Burnett, R. L. Ettenger, O. C. Cromwell, J. A. Pilcher, C. B. Young.

Discussion.

W. C. A. Henry: The circular inquiry requests that the report cover all wheels that broke under fair usage from May 1, 1914, to May 1, 1915. We would like a full report of all the wheels which actually broke; especially in case the failure involved the flange.

M. K. Barnum: Each member of the Association should furnish information when asked for by the committee. I hope the request of the wheel committee will be fully complied with.

The report was accepted and submitted to letter ballot.

REVISION OF THE RULES OF INTERCHANGE.

Rule 1.—It is recommended that the rule read as follows:

"Each railway company must give to foreign cars, while on its line, the same care as to inspection, oiling, packing, adjusting brakes and repairs as it gives to its own cars."

Rule 2.—The Chicago Car Interchange Bureau suggests that in second to last paragraph add the words, "properly side-carded with a bad order transfer, return when empty card, showing the defects for which the car was transferred." New card as follows:

....RAILROAD.

BAD ORDER TRANSFER.

Send to.......................................R. R. Transfer track and

Send to.......................................R. R. when empty for repairs

Account of following defects ....

....

Car No ....Initial ....

Date................. 191 ..

Signed ....
Car Inspector.

The present practice in handling cars that are being transferred is to return the car to the delivering line without any information showing in what condition the car was received, and the reason for its transfer. This results in many cases in cars being returned to the line making the transfer, because the car inspector has no information as to how car was delivered, especially on cars transferred on account of owner's defects, also on cars destined to local industries and returned when empty to the delivering line in the same condition. The adoption of this suggestion will result in many cars being accepted back by the delivering line that are now being returned on account of inspectors having no knowledge as to when and with what defects the car was delivered. This suggestion is approved.

The committee recommends a change in the rule regarding leaking tank cars, as follows:

"Cars containing inflammable liquid which is leaking must be repaired or transferred without unnecessary movement, or at nearest available point."

The committee suggests that the fourth paragraph of Section (e) be changed to read:

"When load is transferred by receiving line, the car, when empty, may be returned to the delivering line properly sidecarded with a bad order transfer, returned when empty card, showing the defects for which the car was transferred, in which case it must be accepted."

The Central Ry. Club recommends as follows: In Paragraph (c) page 4. Insert in brackets on margin the words: "Initial road responsible."

This recommendation is concurred in by the committee in so far as it applies to inside door protection on closed cars, but inasmuch as the change is one in reference to which the Association has no authority to legislate and as the transfer rule is an A. R. A. rule, the question has been referred to that Association for a ruling.

The Western Car Foremen's Association suggests that return card referred to in this rule and shown on page 98 be revised to place date on the card. This suggestion is approved.

Section (c) The committee recommends that this section be changed to read: "Cars improperly loaded (not complying with the Loading Rules) when transfer or rearrangement of lading is necessary."

Rule 3.—The committee recommends a new Rule 3, as follows:

(a) Cars will not be accepted in interchange unless equipped with air brakes having 1¼ in. air-brake pipe and angle cocks; also quick-action triple valve, pressure-retaining valve and an efficient hand brake.

(b) Cars will not be accepted in interchange equipped with stem or spindle coupler attachments.

(c) Cars built after October 1, 1914, with journals or journal bearings other than M. C. B. Standard, will not be accepted in interchange.

(d) Cars built after October 1, 1914, will not be accepted in interchange unless equipped with either the No. 1 or the No. 2 M. C. B. Standard brake beams and so marked plainly on strut by stamping or casting on.

(e) After January 1, 1915, tank cars (empty or loaded) will not be accepted in interchange unless the safety valves are stenciled to show adjusted, etc., within the time limit required by paragraphs 5, 6 and 7 of the M. C. B. specifications for Tank Cars.

(f) After July 1, 1916, cars will not be accepted in interchange unless stenciled showing month and year originally built. Cars built prior to 1895 may be stenciled "Built prior to 1895."

(g) After October 1, 1915, no car built for the purpose of carrying products which require the use of salt with ice for the refrigeration of such products will be accepted in interchange unless equipped with suitable device for retaining the brine between icing stations.

(h) After October 1, 1916, cars will not be accepted in interchange unless equipped with all-metal brake beams.

(i) After October 1, 1916, cars will not be accepted in interchange equipped with continuous draft rods.

(j) After October 1, 1916, no car will be received in interchange unless the body of the car is marked as provided in Rule 86, i. e., either capacity, maximum weight, and on tank cars Limit Weight No. 1 or Limit Weight No. 2.

(k) If the car has air-signal or train-line steam pipes, the hose, pipes and couplings are at owner's risk, unless the car is stenciled that it is so equipped.

(l) When two or more cars chained together, or any car which requires switch chains to handle them, are delivered at an interchange point, the receiving road shall deliver to the delivering road at the time an equivalent number of switch chains of the same size as the chains so used on the cars delivered, or, in lieu thereof, furnish a defect card for such chains.

It is felt that it would be much better to concentrate these special requirements regarding the interchange of cars under one head or rule than to have them scattered all through the book.

Rule 4.—The committee recommends the consolidation of Rules 3 and 4 as Rule 4, because the items cover requirements as to the use of the repair card .

W. J. Stoll suggests adding to this rule suggestion made in Circular 18. The C. I. I. and C. F. Association suggests adding to the second paragraph: "At outlying points where joint inspection is not in effect, the matter will be left to the judgment of the receiving line. At the larger points where chief interchange inspectors are employed, the decision will be made by the chief interchange inspector as a representative of the car owner and the receiving line."

Suggestion approved, as it provides a way to define what constitutes slight repairs.

The committee recommends that the rule be changed to read:

"Defect cards shall not be required for missing material in fair usage from cars offered in interchange. Neither shall they be required of the delivering company for improper repairs that were not made by it, with the exception of the cases provided for in Rules 35, 56, 57 and 70."

Rule 7.—The committee suggests adding to the last paragraph, "in which case the cards must be entered in the billing statement in the first four columns, with the notation 'No bill' in the fifth column for reference," in order to furnish a permanent record of "No bill" repair cards on the bills and to avoid unnecessary and expensive tracing. This will also serve more accurately to fix the responsibility for wrong repairs and thus safeguard the owner.

Rule 9.—The committee suggests the following change: "If M. C. B. Standard brake beam is applied, state whether No. 1 or No. 2, in addition to name of beam."

In first paragraph, page 7, first line, change to read: "When triple valve, cylinder or centrifugal dirt collector is cleaned."

It is further recommended that the standard stenciling for brake cylinders be enlarged to include all cleaning and stenciling of centrifugal dirt collectors by adding a line with the initials "D. C." for dirt collectors; also a line for the date cleaned, shop mark and name of road doing the work. This question is submitted to the Committee on Revision of Standards and Recommended Practice for consideration.

Rule 12.—The committee recommends a new paragraph, as follows: "The joint evidence may be obtained at any point on the home line at which the improper repairs are found, but preferably at the point where the car is received, and only after an actual inspection has been made."

Rule 17.—The committee proposes a revision of the rule as outlined below:

(a) In repairing foreign cars: Defective non-M. C. B. Standards may be replaced with M. C. B. Standards (which must comply with M. C. B. specifications), provided such substitution does not impair the strength of the car. Any increased cost resulting from and any expense of alteration necessary for the application of such M. C. B. Standards shall be charged to the party responsible for the repairs. Any expense of alteration necessary for the application of such M. C. B. Standards to be charged to party responsible for the repairs. Scrap credits to be allowed for undamaged parts thus removed.

(b) Malleable iron, wrought iron or steel M. C. B. Standards may be substituted for each other or for gray iron M. C. B. Standards. Gray iron M. C. B. Standards applied in lieu of malleable iron, wrought iron or steel M. C. B. Standards shall be considered as wrong repairs.

(c) In replacing M. C. B. Standard couplers or M. C. B. Temporary Standard couplers the dimensions of shank and butt of M. C. B. couplers standard to the car must be maintained.

(d) If the car owner elects on account of improper repairs to remove M. C. B. Standard or M. C. B. Temporary Standard coupler in good condition, secondhand credit should be allowed, and charge be confined to secondhand coupler applied.

(e) When necessary to renew brake beam, any metal brake beam meeting M. C. B. specifications may be used, provided that the beam applied is at least as strong as the beam standard to the car.

(f) Billing repair card to specify kind of material applied and removed, and bill rendered in accordance therewith.

(g) Cast-iron brake shoes may be replaced with brake shoes having reinforced back and the increased cost charged to party responsible for the repairs.

(h) White pine, yellow pine, fir or cypress may be used when repairing siding, when of equal grade or quality to the material standard to the car. Fir, oak or southern pine may be substituted for each other in renewing or splicing of longitudinal sills.

Reason: To discourage the use of non-M. C. B. Standard material and facilitate freight-car repairs.

Rule 18.—O. S. Jackson and A. C. Deverell suggest amending the third paragraph of rule to read "October 1, 1916."

Reason: Time allotted too short and the additional two years will be only a reasonable length of time to get cars home and make necessary changes.

It is recommended by the committee that the time be extended until October 1, 1916.

It is called to the attention of car owners who have cars on their line with American continuous draft rods that, while the extension of time is recommended, they should not abate their efforts toward getting such draft rods out of service. It is also called to the attention of members of the Association that there are other draft carrier construction on the same principle as the American continuous draft and that these are also covered by the rule.

Rule 19.—R. E. Smith suggests changing the word "shall" in second line to "must."

The suggestion is approved.

Add to the rule: "Cast-iron brake wheels." The suggestion is approved.

Rule 20.—The Central Railway Club, Pittsburgh Railway Club and J. E. Keegan suggest changing, in third line, first paragraph, the word "may" to "must," and adding the following to the paragraph: "When construction of car and trucks precludes the common methods of adjusting coupler heights, the application of metal shims between journal boxes and arch bars will be permissible." The suggestion is approved.

Rule 21.—The Central Railway Club and J. E. Keegan suggest adding the following clause: "Also for applying temporary transverse tie rods to cars with sides spread or bulged beyond the clearance limits of the handling line."

The committee approves of the suggestion. When it is necessary to apply transverse tie rods on account of car sides being bulged out, they should be charged against the owner of the car, because such spreading or bulging is an indication of weak construction.

Rule 28.—The committee proposes that the rule be made vacant. The first part of the rule is already covered in Rule 87. The committee recommends adding the latter part of the rule to Rule 87 as an additional exception.

Rule 29.—The committee recommends that this rule be reworded: "When secondhand axles are applied the journals must not exceed ⅜ in. over the standard length and the collar must be not less than 3/16 in. thick. The diameter of the wheel seats or centers must not be less than, or the diameters of the journals must be at least ⅛ in. greater than, the limiting diameters given in Rule 86"—balance of rule as at present.

The committee also proposes to the Association that the wheel and axle committee investigate the propriety of maintaining the item of limit of collars on axles at less than ¼ in., having in view the increased car capacities and the safety of this limit for these cars. This information should properly be shown by an additional column in the tabulations in Rule 86.

Rule 33.—The committee proposes a new rule, as follows:

"The following will not be considered as an owner's responsibility: "Straightening or replacing ladders, handholds, sill steps or brake shafts."

Rule 35.—The New England Railroad Club suggests new paragraph: "After January 1, 1915, cars not equipped with M. C. B. Standard axles, journal boxes and contained parts will not be accepted in interchange."

The committee does not approve. It considers the recommendation desirable, but does not believe it can be carried out in practice.

Also, another new paragraph: "After October 1, 1916, tank cars not equipped with suitable jacking castings will not be accepted in interchange." The committee believes this a desirable suggestion, but would refer it to the Tank Car Committee for investigation.

F. H. Clark suggests change in third paragraph, page 25, to read: "After October 1, 1915, cars not having stenciled the year and month when built new will not be accepted in interchange."

The committee proposes an extension of time until July 1, 1916; also that the date car was built means the month and year the car was built. See new Rule 3.

Rule 37.—The committee has considered the various recommendations regarding the combinations of defects in Rules 37 to 42, inclusive, and notes that a strong sentiment exists in favor of eliminating all the combinations, but feels that the time is not yet ripe for the complete elimination of all combinations and would therefore make the following suggestion:

Eliminate Rules 37 and 39 and the notes following Rule 42 with reference to continuous draft rods and missing couplers, for the reason that a coupler very seldom appears as a factor in these combinations.

Rule 42.—The committee recommends the elimination of the first two notes following this rule, as the elimination of Rules 37 and 39 makes these notes unnecessary; also the substitution therefor of the following note:

"When a combination of defects involves decayed parts, or involves longitudinal sills requiring renewal or splicing, due to elongated holes, or to sills split on this account, a joint inspection statement, made as per Rule 120, shall accompany the billing repair card, which together will be authority for bill against the owner," so as to make unnecessary the present practice of holding the car for such repairs until owner's authority can be procured.

Rule 43.—Central Railway Club and J. E. Keegan suggest extending bracket on left to include heading "All-steel underframe or all-steel cars."

The committee approves this suggestion.

Rule 46.—The committee recommends that this be transferred to paragraph (k), Rule 3.

Rule 47.—The committee suggests that the rule be transferred to paragraph (1), Rule 3.

Rule 52.—The committee suggests the rule be changed to read as follows:

Inside bracket:

"Running boards in bad order or insecurely fastened"—owner's responsibility.

Outside bracket:

"In making repairs to safety appliance details, nails or lag screws must not be used where screws, bolts or rivets are required by law. Handholds or grabirons must be of wrought iron or steel."

Rule 56.—The M. St. P. & S. S. M. suggests that second paragraph in regard to brake beams be changed so that railroads will be given much more time to equip cars with metal beams or have former action entirely rescinded.

F. A. Torrey and T. H. Goodnow suggest that date regarding brake beams be extended to 1916.

The committee suggests an extension of time. See revised Rule 3.

Rule 57.—The Pittsburgh Railway Club, Central Railway Club and J. E. Keegan suggest cutting out air hose and label on page 31 and modify it to show that label is located within 6 in. of hose coupling.

The recommendation is approved, for the reason that it renders the label observable from both sides of the car, and the label in this position is less liable to injury from chafing.

Also change third and fourth paragraph to read: "After October 1, 1914, the delivering line will be responsible for hose not conforming with the 1913 M. C. B. Standard specifications and so labeled, except that 1905 M. C. B. specification hose, the date of which shows it was manufactured before October 1, 1914, may continue in service until it is worn out."

Rule 59.—The committee proposes that the Executive Committee refer to the Train Brake and Signal Committee the question of proper location of centrifugal dirt collectors, for the reason that some roads are applying them in such position that they trap the water from the train line, and consequently are liable to freeze in the winter time.

Rule 62.—The committee recommends that this rule be changed to read: "In replacing air-brake hose on foreign cars, new M. C. B. Standard 1913 specification hose must be used."

Rule 66.—S. G. Thomson suggests after the word "with" insert "axles or," so as to read "axles or journal bearings," etc.

Reason: To enforce the use of M. C. B. standard axle and journal bearing.

W. H. Lewis suggests eliminating this rule, as it is covered in Rule 35.

Both suggestions are approved, see rewording in revised Rule 3.

Rule 69.—The committee recommends that the rule be changed to read:

"Broken flange; chipped flange, if chip exceeds 1½ in. in length and ½ in. in width. Broken rim, if tread measured from flange at a point ⅝ in. above tread is less than 3¾ in. in width (see Fig. 5), provided these defects are caused by derailment or wreck."

Rule 78.—The committee recommends changing rule to read:

"Cracked or broken flange, chipped flange, if it exceeds 1½ in. in length and ½ in. in width; broken or chipped rim, if tread measured from the flange at a point ⅝ in. above tread is less than 3¾ in. in width (see Fig. 5); cracked tread, cracked plate, one or more cracked brackets, or broken in pieces, provided these defects were not caused by derailment or wreck."

Rule 79.—The committee recommends that this rule be made vacant, because it is included in Rule 78.

Rule 80.—The committee recommends that the first paragraph be eliminated, because it has been included in Rule 78.

Rule 82. The committee suggests that this rule be made vacant, because it has been included in Rule 78.

Rule 83.—The reference on page 41, under Fig. 5, should be changed to read: "See Rules 6, 9 and 78."

Rule 87.—The committee suggests that the rule be changed to read:

"Any company making improper repairs is solely responsible to the owner, with the exception of the cases provided for in Rules, 3, 56, 57 and 70, and excepting that a company applying axles smaller than the limits given under Rule 86 shall not be held responsible for improper repairs if the car is not stenciled showing the capacity or maximum weight, or Limited Weight I or Limited Weight II."

Rule 88.—R. E. Smith and New England Railroad Club suggest changing the word "shall" to "must" in the second line.

The committee approves.

Rule 90.—The only change the committee suggests is to change the reference to Rule 3 instead of Rule 35.

Rule 91.—R. E. Smith suggests changing the word "should" to "must" in the third line of note under this rule.

The suggestion is approved.

Rule 95.—The committee suggests that the second and third paragraphs be changed to read:

"Brake beams, including shoes, heads, jaws, key bolts, cotters, brake pins and hangers, when lost with the brake beam.

"Brake levers, lever guides, key bolts, pins, cotters, top and bottom brake rods, whether or not they are lost with the brake beam."

"Labor and material may be charged for key bolts, cotters and brake pins when lost independently of above items," to clarify the rule as previously written.

Rule 105.—The committee suggests that a note be added to this rule, as follows:

"NOTE.—Manufactured articles are those which are not subject to competitive prices, and which can only be obtained from one manufacturer or concern," to more fully explain the term used.

Rule 112.—The committee recommends that Rule 112 be changed to read as follows:

"When the body or trucks of a foreign car are destroyed or badly damaged, the owner shall, upon request, furnish depreciated value of body and trucks separately (the same to be figured from the date the car was originally built), and the party damaging shall have the option of rebuilding or settling under the depreciated value.

"If it is decided not to rebuild, the owner must be immediately advised."

Rule 115.—The committee suggests that the last phrase of the last paragraph be changed to read: "Except that secondhand value will be allowed for all metal brake beams good for further service and the average credit price for wheels," to conform with the interpretations given in Circular No. 26.

The committee would also recommend the abolition of the last paragraph of this rule (top of page 84) in reference to the underframes of damaged steel and steel-underframe cars, because the adoption of revised Rules 112 and 120 will render this provision no longer necessary.

Rule 120.—The committee recommends that the rule be changed to read as follows:

"A car unsafe to load on account of general wornout condition due to age, decay or corrosion, shall be jointly inspected by the handling line and a representative of the owner of or a disinterested line, whichever can be most conveniently obtained by handling line. If inspectors agree that the car is unsafe to load on account of general worn-out condition due to age, decay or corrosion, the result of such joint inspection, entered on form shown on page 4, shall be sent to the car owner, showing in detail all defects found on car, also an estimate of the cost to rebuild the car. Upon receipt of this information the owner must either authorize the destruction of the car, or authorize the handling company to rebuild it. In the latter case the owner must forward to the handling company complete plans and specifications necessary for the rebuilding of the car. If the owner elects to have the car destroyed, the handling line shall be allowed credit for all material at M. C. B. scrap prices, less labor cost for destruction."

Rule 121.—The committee suggests that rule be eliminated, as it is taken care of in revised Rule 112.

Rule 122.—The committee suggests adding in the third line, first paragraph, preceding the word "charges," the words "or express and," an additional paragraph, as follows:

"Material weighing less than 125 lb. gross weight ordered from car owner should be shipped by express," to assist in the more prompt repairs of cars.

PASSENGER CAR RULES.

Rule 3.—Central Railway Club, the C. I. C. I. & C. F. Association suggests adding as an owner's defect: "Equipment and tools missing from the inside of baggage, mail and express cars are an owner's defect when missing at the time of unloading."

The committee approves the idea, but recommends that it should read as follows:

"Equipment and tools missing from the inside of baggage, mail and express cars are an owner's responsibility."

Rule 17.—The committee recommends the following:

"All inside or concealed parts of passenger equipment cars are at owner's risk."

Discussion.

Secretary Taylor: The arbitration committee has two additional suggestions to make. Rule 3, Section M. (a new section): "On and after October 1, 1916, refrigerator cars not equipped with door hooks and fasteners, to secure the doors in the open position, will not be accepted in interchange." An additional note to Rule 30, as follows: "The marked weight shall be the multiple of 100 lb. nearest the scale

weight except that when the scale weight indicates an even 50 lb., the lower multiple shall be used."

The recommendations of the arbitration committee concerning the changes in rules of interchange were approved.

PRICES FOR LABOR AND MATERIAL.

The special committee, appointed to suggest additional prices or modifications of present prices in the rules of interchange, did not prepare a circular of inquiry this year, for the reason that it was thought proper by the committee to review the work already done and make such changes as to make the rules clearer, as well as make such changes in the present prices as would more nearly represent the average cost of labor and material used in making repairs to car equipment, and add such other items as were presented to them by the Arbitration Committee from time to time for their consideration, and new items which the committee found necessary in connection with its work.

The committee suggests that for next year special attention be given to the passenger car price rules, in order that they be brought up to the standard of the freight car price rules.

The following changes are presented for approval:

Rule 98.—If new wheels and axles are substituted for average credit price wheels and secondhand axles, proper charges and credits shall be allowed, although such substitutions be made on account of only one loose or defective wheel or a defective axle, with the following exceptions: In case the owner of a car removes a damaged wheel or axle, no charge shall be made for any difference in value between the parts used and those removed that are not damaged.

The price for forged or rolled steel wheels shall be based on the scrap value of $4.50 for metal inside the condemning limit (which is ¼ inch above the limit groove) plus $0.625 for each $\frac{1}{16}$ inch of service metal (on radius of tread) in connection with standard full flange contour.

No credit will be allowed owner for loss of service metal due to turning off wheels. Should there be a further loss of service metal, however, due to the application of other wheels, the proper credit for such additional loss must be given the owner. Any increase in the amount of service metal, due to the application of other wheels, may be charged to the owner.

When repairs are not covered by a defect card, the proper credit for any loss of service metal must be given the owner; and charge shall be made against the owner for any increase in the amount of service metal, due to application of other wheels.

When the repairs are covered by the defect card of another company, charge covering such repairs shall be made against the owner of the car, the defect card and the billing repair card to be attached to the bill. The owner to render counter bill on the authority of the defect card against the company issuing same, including an additional charge to cover the loss of service metal on account of the defects covered by the card. Should there be an additional loss of service metal, on account of the application of other wheels, the company making the repairs shall allow the proper credit to the owner to cover such additional loss of metal. Should there be an increase in the amount of service metal, due to the application of other wheels, such increase may be charged to the owner.

The above provisions shall govern any loss or increase of service metal on account of the mate wheel, even if same is not defective, when both wheels are turned off to correspond.

The necessary information must be given in all cases, as provided in Rule 10.

In cases of slid-flat wheels ⅛ in. for loss of service metal will be allowed for flat spots 2½ in. long and $\frac{1}{16}$ in. for each additional inch or fraction thereof.

Repairs of Steel or Steel Parts of Composite Cars.—All rivets ½-in. diameter or over, 14 cents net per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splicing and replacing damaged parts, not to include straightening.

All rivets ¼-in. diameter and less than ½-in. diameter, 8 cents net per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splices and replacing damaged parts, not to include straightening.

Straightening or repairing parts removed from damaged car, 60 cents per 100 pounds.

Straightening or repairing parts in place on damaged car; also any part that requires straightening, repairing or renewing, not included on rivet basis, 28 cents per hour.

Repairs of steel tanks of tank cars:

Labor, repairing and testing, per hour.......................... $0.40
Steaming, per tank.. .75
Water for testing, per 1,000 gallons.......................... .06

In making repairs to cars on rivet basis, the cost of removing and replacing fixtures not secured by rivets, but necessarily removed in order to repair or renew adjacent defective parts, should be in addition to the rivet basis; rules covering wood-car repairs to govern.

Dismantling wood constructed cars, including trucks and all work necessary including handling, assorting and weighing scrap.

Box, stock and other house cars, except refrigerators............ $10.00
Flat car.. 6.50
Gondola or hopper car, having sides over 36 inches............ 9.00

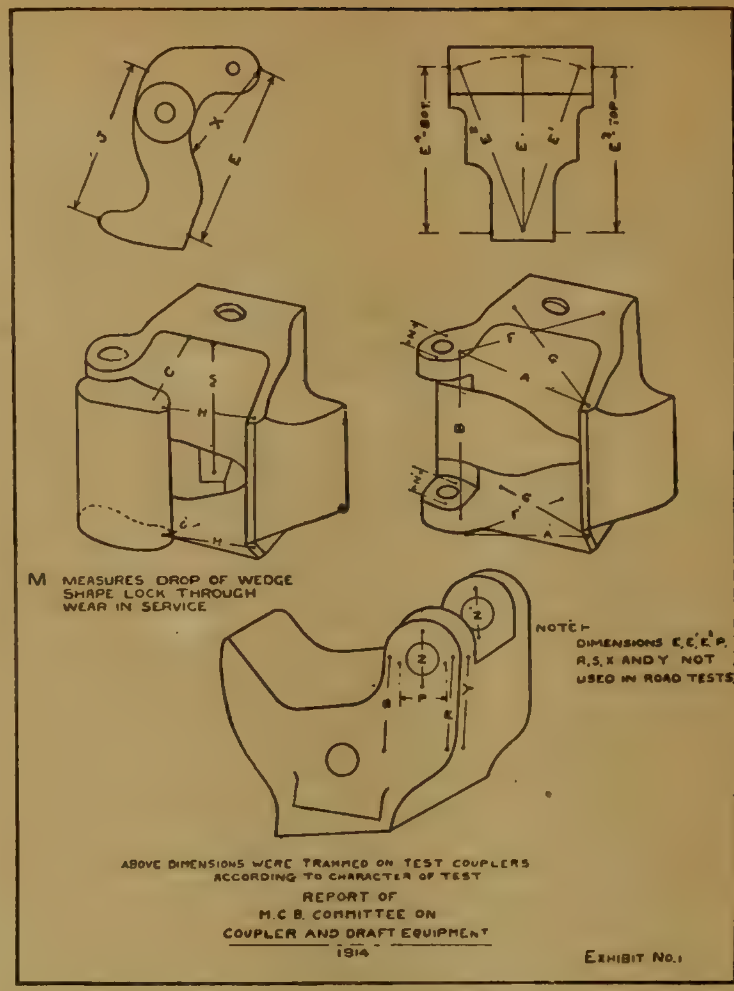


Fig. 1—Points for Testing.

PULLING TESTS OF COUPLERS EXHIBITED AT 1913 CONVENTION BY M. C. B. COMMITTEE—COMPARISON OF PERMANENT SET AT "C" (KNUCKLE OPENING) AND "E" (KNUCKLE STRETCH).

Present standard M. C. B. pulling test is 150,000 lb. Pull with limit knuckle opening of (C) 0625 in.

Test Shown on Exhibit No.	Coupler.	Permanent Set "C" Inches. At 2000,000 Lbs. Top.	Bottom.	Average.	At 300,000 Lbs. Top.	Bottom.	Average	At 400,000 Lbs. Top.	Bottom.	Average	Permanent Set "E," Inches At 150,000 Pounds.	175,000 Pounds.	200,000 Pounds.	Ultimate Pounds.	Weight Pounds.	Pounds Ultimate Per lb. Weight.
3	Tc	.013	005	009	067	[redacted]	052	.145	.167	.156	[redacted]	[redacted]	005	545 000	480	1 135
14	Tc	.026	066	.046	078	[redacted]	102	226	.297	261	0	[redacted]	0	531 440	468	1 136
4	Td	.171	213	.192	.121	.121	121	203	207	[redacted]	0	0	008	620 000	517	[redacted]
15	Td	0	0	[redacted]	043	068	055	249	[redacted]	243	0	[redacted]	0	531 200	506	[redacted]
5	Uc	150	.116	[redacted]	399	335	[redacted]	.....	....	....	.009	014	021	388 600	[redacted]	[redacted]
6	Ue	236	[redacted]	.219	.641	.583	.612	.....	.....	.....	.015	[redacted]	055	[redacted]	449	792
16	Vb	.117	121	.119	427	.562	.494	.....	....		[redacted]	010	030	345 940	473	731
17	Vb	083	200	.141	.486	858	.672	..	....	.	.015	[redacted]	050	319 480	460	695
7	Wb	049	082	065	212	209	210	.726	.642	684	0	[redacted]	0	451 020	480	[redacted]
18	Wc	.147	170	.158	447	401	.424	1 257	1 133	1 195	0	011	062	423 320	483	876
8	Xc	106	043	074	210	126	[redacted]	.468	[redacted]	412	0	[redacted]	011	465 130	[redacted]	1 118
[redacted]	[redacted]	.137	132	.134	[redacted]	[redacted]	210	.483	411	[redacted]	0	0	0	449 800	425	[redacted]
9	Ye	[redacted]	038	037	119	.117	.118	300	306	303	0	0	0	495 220	[redacted]	1 060
[redacted]	Ye	029	040	[redacted]	.186	.191	188	[redacted]	667	614	0	0	007	460 130	473	[redacted]
10	Yf	[redacted]	003	.012	190	.165	.177	428	[redacted]	435	0	0	006	531 660	[redacted]	1 187
21	Yf	[redacted]	087	111	240	215	.227	652	583	.617	[redacted]	[redacted]	014	[redacted]	453	966
Average	. .	091	095	.093	.257	268	262	475	[redacted]	464	0024	0081	[redacted]	[redacted]	[redacted]	988

Table I.

Couplers.	Weight Complete Pounds.	Average Top (C) and Bottom (C.) Permanent Set at "C" (Knuckle Opening) at 150,000 Lbs. Inches Total.	Per Pound of Weight.	Load at M. C. B. Limit (.625 in.) of Set at "C" or Load at Set Nearest to Limit. Pounds.	Set Inches.	Ultimate Load, Pounds. [redacted]	Per Pound of Weight.	Principal Failure.
Present								
Ta	280	252	00090	221 000	625	260 000	929	Knuckle hub.
Ua	312	282	00090	255 000	.625	320 000	[redacted]	Knuckle shank
Wa	300	292	00097	212 000	625	260 000	[redacted]	Knuckle hub
Xa	284	302	00106	198 000	625	248 000	[redacted]	Knuckle hub
Xb	[redacted]	371	[redacted]	196 000	625	232 220	880	Top ear
Ya	302	283	00094	200 000	625	260 000	[redacted]	Knuckle hub.
Yc	300	352	00117	192 000	625	231 860	773	Knuckle pulled past lock.
Average	292	305	00105	210 571	625	261 725	896	
Committee Specification.								
Tc	480	019	00004	500 000	[redacted]	[redacted]	1 135	Shank near liner block.
Tc	468	037	00008	471 690	625	[redacted]	1 136	Knuckle hub.
Tb	517	192	00037	526 720	625	620 000	1 199	Shank at liner block.
Tb	506	026	00005	531 200	562	531 200	1 050	Shank at liner block.
Uc	448	[redacted]	00021	345 580	625	388 600	867	Rear of bottom ear.
Uc	[redacted]	115	00028	[redacted]	625	355 720	792	Knuckle shank.
Vb	473	032	00007	300 000	[redacted]	[redacted]	731	Bottom ear hole.
Vb	460	[redacted]	00021	293 000	625	319 480	695	Bottom ear hole.
Wb	480	034	00007	389 380	625	451 020	[redacted]	Knuckle hub.
Wc	483	076	00016	336 410	625	423 320	[redacted]	Knuckle hub.
Xc	416	058	00014	450 000	618	465 130	1 118	Rear of coupler pulling ribs.
Xd	425	077	00018	400 000	447	449 800	1 058	Knuckle hub.
Ye	467	047	00010	450 000	429	495 220	1 060	Knuckle hub.
Ye	473	081	00017	400 000	614	[redacted]	973	Knuckle hub.
Yf	448	...	...	446 000	625	531 660	1 187	Knuckle hub.
Yf	453	049	00011	400 000	617	[redacted]	966	Rear of both ears.
Average	465	0644	00014	408 806	575	459 444	988	
Increase				94.1%		75 5%	10.3%	
Decrease		78 9%	86 9%		8 7%			

NOTE.—All the present type couplers were 5 by 7 in. shank except Ua, which was 5 by 5 in., and all the committee specification couplers were 6 by 8 in. shank and made from wooden patterns, which increased the weight over regular foundry practice.

Table II.

Gondola or hopper car, having sides 36 inches and under........ 8.00
Refrigerator.. 12.00

Test Bar.	Date.	Set—Plus or Minus from Original Dimension.						Gage.	
		C	C1	H	H1	E3	E4	Top	Bottom.
No. 648	4-14-14	+.24	+.11	+.17	+.19	—.10	—.05	$4\frac{15}{16}$	$4\frac{29}{32}$
No. 650	4-17-14	+.29	+.17	+.26	+.18	—.08	—.04	$4\frac{15}{16}$	$4\frac{29}{32}$
No. 651	4-23-14	+.30	+.08	+.47	+.26	—.05	—.04	$5\frac{1}{32}$	$4\frac{31}{32}$
No. 653	4-27-14	+.22	+.12	+.11	+.17	—.08	—.03	$4\frac{31}{32}$	$4\frac{31}{32}$
No. 686	4-1-14	+.27	+.16	+.37	+.25	—.06	—.04	$5\frac{1}{32}$	5
No. 689	4-15-14	+.28	+.18	+.20	+.21	—.09	—.04	5	$5\frac{1}{32}$
Average		+.267	+.137	+.263	+.21	—.077	—.04	$4\frac{63}{64}$	$4\frac{31}{32}$
		+.202		+.237		—.058		4.974	

Table III—Tb Couplers.

Test Bar.	Date	Set—Plus or Minus From Original Dimension.						Gage.	
		C	C1	H	H1	E3	E4	Top.	Bottom.
No. 636½	2- 1-13	— 08	— 05	+ 01	+ 02	......	......		
No. 638	1- 6-13	+ 03	......	+ 15	+.06	— 02	— 01		
No. 639	4- 1-14	— 10	— 01	+ 03	+.06	— 11	—.04	$4\frac{19}{32}$	$4\frac{17}{32}$
No. 646	2-14-13	— 13	— 21	+.04	+ 07	— 05	—.01		
No. 641	11- 1-12	— 13	— 04	+.18	......	— 11	—.10		

Table IV—Yd Couplers.

Test Bar.	Date.	Set—Plus or Minus from Original Dimension.						Gage.	
		C	C1	H	H1	E3	E4	Top.	Bottom.
No. 703	4-17-14	+.11	+.06	+.20	+.24	—.04	—.05	$4\frac{27}{32}$	$4\frac{7}{8}$
No. 704	4-15-14	+.08	+.17	+.24	+.17	—.06	—.05	$4\frac{13}{16}$	$4\frac{13}{16}$
No. 705	4-14-14	+.04	+.09	+.17	+.13	—.05	—.01	$4\frac{27}{32}$	$4\frac{27}{32}$
Average		+.077	+.107	+.203	+.180	—.050	—.037	$4\frac{53}{64}$+	$4\frac{27}{32}$
		+.092		+.191		—.043		$4\frac{27}{32}$	

Table V—Yda Couplers.

Test Bar.	Date.	Set—Plus or Minus from Original Dimension.							Gage.	
		C	C1	H	H1	E3	E4	M	Top.	Bottom.
No. 714	4-17-14	— 26	—.14	—.04	—.16	—.06	—.03	+1.16	$4\frac{1}{2}$	$4\frac{17}{32}$
No. 715	4-27-14	—.14	—.11	+.08	—.06	—.07	—.04	+.63	$4\frac{17}{32}$	$4\frac{17}{32}$
No. 716	4-17-14	—.14	— 16	—.02	—.07	—.07	—.02	+.54	$4\frac{9}{16}$	$4\frac{19}{32}$
Average		— 18	— 137	+ 007	— 097	—.067	—.03	+.78	$4\frac{17}{32}$	$4\frac{35}{64}$+
		— 158		—.045		—.048			$4\frac{35}{64}$	

Table VI—Ydb Couplers.

Couplers.	Test Bar No	Date.	Time in Service.	Set-Plus or Minus-Inches from Original Dimension.						Gage.	
				C	C1	H	H1	E3	E4	Top.	Bottom.
Ta	620	4-16-14	20 months, 20 days	+.34	+.29	+.03	+.17	+.05	+.06	$4\frac{27}{32}$	$4\frac{7}{8}$
Ta	621	4-15-14	20 months, 20 days	+ 25	+.16	+.08	+.17	+ 06	+ 07	$4\frac{25}{32}$	$4\frac{25}{32}$
Ua	600	3-31-14	20 months, 4 days	+.26	+.31	+.17	+ 27	+.13	+.08	$4\frac{31}{32}$	$4\frac{31}{32}$
Ua	601	2- 4-14	18 months, 8 days	+.18	+.21	+.13	+ 28	+.03	+ 05	5	$5\frac{1}{32}$
Wa	604	4- 6-14	20 months, 10 days	+.24	+.44	+.24	+ 33	—.04	+ 26	$5\frac{1}{32}$	$5\frac{3}{32}$
Wa	605	4- 6-14	20 months, 10 days	+.18	+.31	+.17	+ 24	—.07	+.16	$4\frac{7}{8}$	$4\frac{7}{8}$
Xa	608	4-16-14	20 months, 20 days	+.33	+.22	+.15	+.26	—.05	—.06	$5\frac{1}{16}$	$5\frac{1}{16}$
Xa	609	4-16-14	20 months, 20 days	+.17	+.18	+.13	+.17	+.03	+.04	$4\frac{31}{32}$	$5\frac{3}{32}$
Ya	612	4- 6-14	20 months, 10 days	+.28	+.30	+.17	+.23	+.13	+ 12	$4\frac{29}{32}$	5
Ya	613	4- 6-14	17 months, 5 days	+.21	+.24	+.17	+.32	+.06	+ 07	$4\frac{27}{32}$	$4\frac{15}{16}$
Yc	616	4-16-14	20 months, 20 days	+.14	+.17	+.04	+.13	+.01	+ 06	$4\frac{3}{4}$	$4\frac{3}{4}$
Yc	617	4-16-14	20 months, 20 days	+ 26	+.26	+.07	+.23	— 03	+ 08	$4\frac{27}{32}$	$4\frac{7}{8}$
				+.237	+.257	+.133	+ 233	......	......	$4\frac{29}{32}$	$4\frac{15}{16}$+
Average, all bars			20 months, 1 day	+.247		+.183		......		$4\frac{59}{64}$	

Table VII—Summary of 12 Couplers of Present Type in Freight Car Service.

Rule 116.—Change last sentence to read: "For trucks with steel or steel-tired wheels, an additional allowance of $84.00 per car shall be made."

Committee:—F. H. Clark, (chairman), C. E. Carson, C. F. Thiele, Ira Everett, H. H. Harvey, C. F. Giles and C. N. Swanson.

The report of the committee was accepted and approved.

THURSDAY, JUNE 18.

COUPLER AND DRAFT EQUIPMENT.

The committee last year reported in more or less detail the progress of the work of designing the standard coupler, giving the results comparatively and individually of the series of static, dynamic and road service tests on couplers in present general use and of several types of couplers of increased weight and strength in the development stage, the latter having been termed "Experimental." The comparisons and summaries in all the tests showed conclusively that the experimental couplers were much stronger throughout than present types of couplers and that the committee is working along the right lines.

Last year a series of static pulling tests consisting of two couplers of each design submitted by the coupler manufacturers and exhibited by the committee was instituted at Altoona shops, Pennsylvania Railroad, under the direct supervision of C. D. Young, Engineer of Tests. The pulling tests on these couplers were made in the same manner

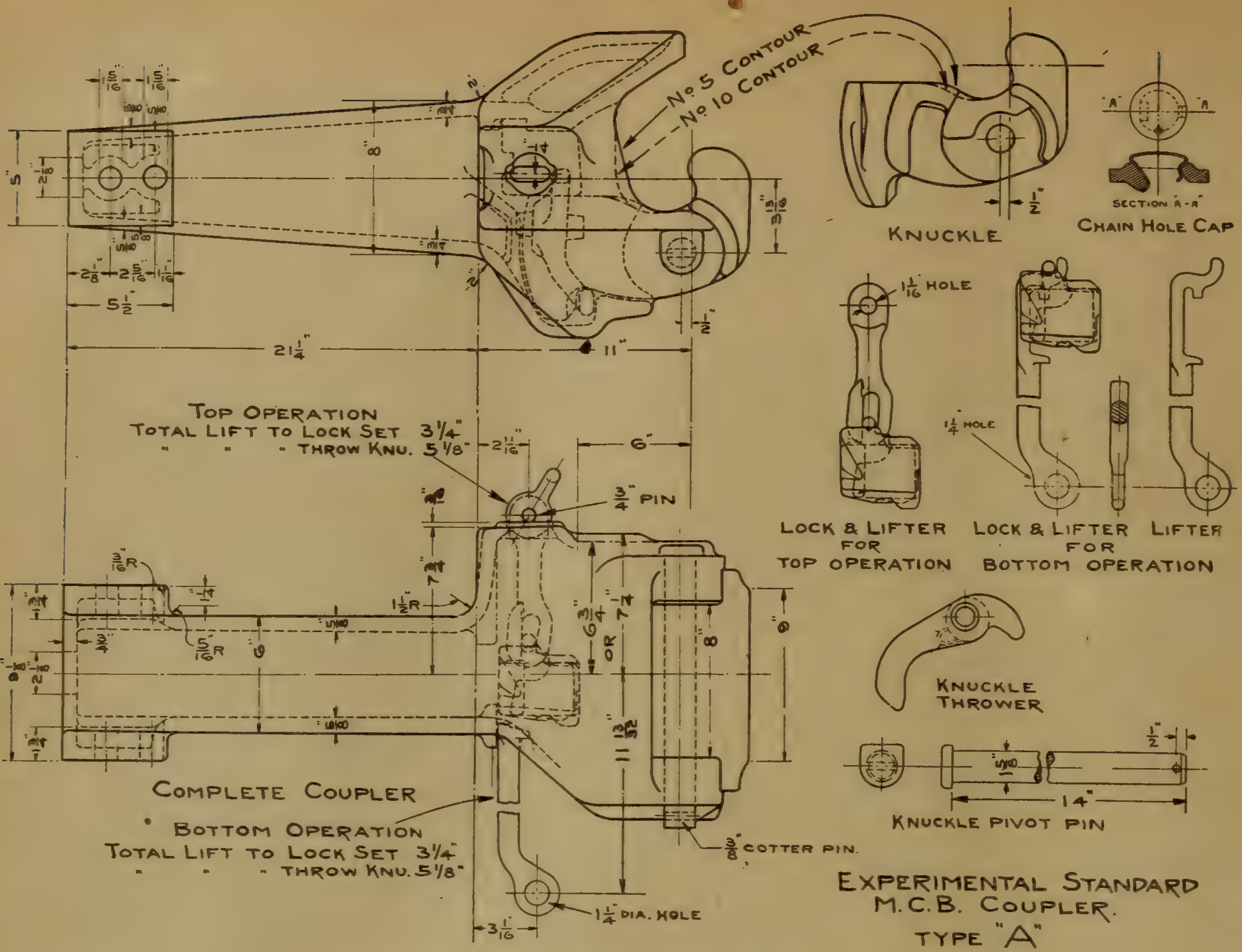


Fig. 2—No. 3 Modified Alliance Coupler.

as those reported on last year, viz., by laying the couplers off as per Fig. 1 and measuring both deflection and permanent set after each increment of load and tabulating the distortions by so much plus or minus from the original dimensions.

The results of all the individual tests were plotted graphically and, taking the coupler giving the higher ultimate and the one giving the lower ultimate of each two furnished by each manufacturer and grouping them, comparative summaries of the important dimensions C, H and E in the tests of both groups were also plotted.

Table I gives a comparison in figures of permanent set at "C" (knuckle opening) and "E" (knuckle stretch). These couplers were built to cover the same specifications and were hence considerably reduced to a common basis, and even though they were built in somewhat of a hurry, made from wooden patterns and without time for sufficient experimenting for molding purposes, the results were very good, as will readily be seen from a study of the table.

Table II is a comparison of results of pulling tests of these specification couplers with results of similar tests of present couplers in general use, as reported last year. (Page 129, 1913 Proceedings.) These comparisons show a decided decrease in permanent set and increase in strength of the specification couplers.

ROAD TESTS.

The road-service tests of couplers, reported on last year (pages 140 to 153, 1913 Proceedings), were continued and are herein given with results up to date of writing the report. As in all tests, each coupler was given a letter designation by the committee to represent the name or type of the coupler tested, as well as the manufacturer. Couplers Ta, Ua, Wa, Xa, Ya, and Yc represent couplers of the latest types in general service, such as Pitt, Sharon, Major, Simplex, Latrobe and Gould "Z," irrespecively, and couplers, Tb, Xe, Yb, Yd, Yda and Ydb represent couplers of increased weight and strength in the development stage, termed "Experimental," a number of each of which were placed in service experimentally.

These road-service tests were conducted with couplers of present type on freight cars and with couplers of both present and the experimental design on freight locomotive tenders on the Pennsylvania Railroad. The freight-car couplers were applied to 100,000 lb. capacity steel hopper cars in the coal trade between the bituminous mines in western Pennsylvania and tide-water, a service comprising grade and flat country as well as hump-yard classification. The tender couplers were applied to 7,000 gal. steel tenders in general heavy freight service on the Western Pennsylvania Division, between Altoona and Pittsburgh, which includes heavy grade service.

Some of the results showing the measurements C, H and E in inches are shown in tables III, IV, V, VI and VII.

CONFERENCES WITH COUPLER MANUFACTURERS.

In reporting upon and exhibiting to the Association last year the various designs of couplers, which were submitted to the committee by the respective coupler manufacturers as embodying the specifications on design jointly agreed upon by both, the committee stated that the coupler manufacturers had designed the working parts of the couplers thus submitted according to their ideas to meet these specifications, and that it was essential to select from these couplers several designs to be tried out in service during the ensuing year to definitely determine the best contour line, efficiency of operation and strength of the various parts, with a view of harmonizing the designs thus chosen and eliminating any details that may prove unsatisfactory to the end of establishing the standard coupler.

Each coupler submitted was taken up and each minute detail, both of design and operation, was considered and thoroughly discussed, and by carefully weighing all the points at issue it was decided to try out two couplers, and the following were selected to enter the elimination trial in service:

American Steel Foundries No. 3 modified Alliance coupler.

The National Malleable Castings Co. Bazeley coupler.

These are shown in Figs. 2 and 3.

These couplers have straight locks and were selected for the general trial, but the committee did not feel like giving up the advantages dormant in the wedge-lock principle, which is applicable to most coupler designs, nor did the committee desire that a wedge-lock coupler be tried out in service in general, hence it was decided to make and confine further experiments with this wedge principle under the direct supervision of the committee. The coupler selected for these trials was:

The National Malleable Castings Co. Bazeley coupler wedge lock.

HEIGHT OF COUPLER HEAD ABOVE CENTER LINE.

A meeting of representative of coupler committee, American Steel Foundries and the National Malleable Castings Company, was held at Altoona, Pa., August 21, 1913, to determine upon the height of head above center of the standard freight-car coupler, with particular regard for use of same coupler head on locomotive tenders and that it may couple to passenger cars and not have interference between tender coupler and passenger-car buffer, or vice versa, when the heights of coupler and bottom of buffer vary to opposite extremes, as in service a condition is sometimes present of having one coupler 31½ in. and the mating coupler 34½ in. above top of rail, therefore, provision for a 3-in. variation is necessary.

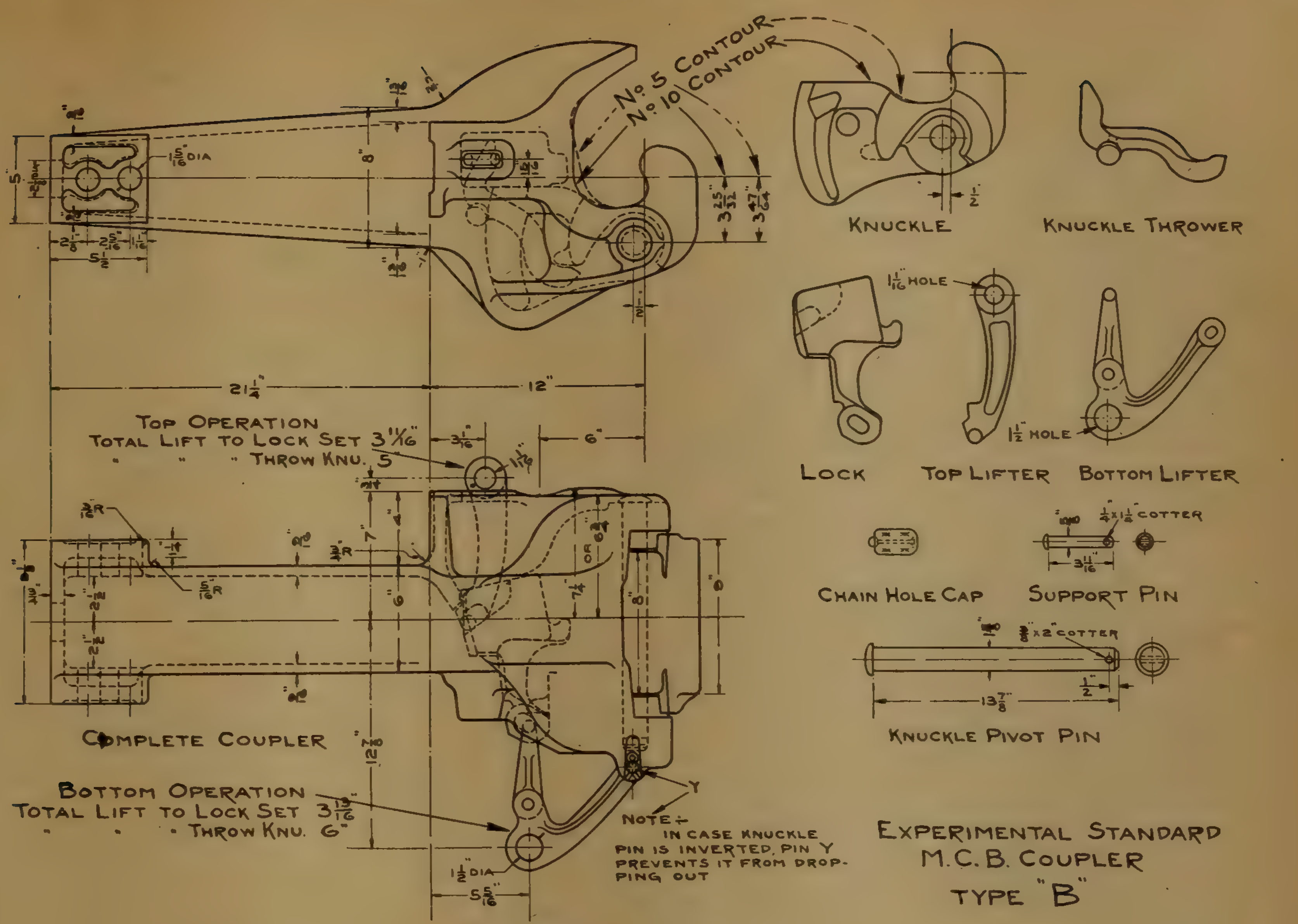


Fig. 3—Bazeley Coupler.

The ordinary distance from center line of passenger-car coupler to bottom of buffer is about 9½ in., subtracting the 3-in. difference in coupler height leaves 6½ in. for the height of coupler head above center line of its shank.

It would be well to keep the head as low as possible throughout its entire length, but, due to amount of lift required for the locking pin, this is often not possible, and where such is the case the head should be kept as low as possible back to the locking pin, or a safe distance, and then raised, the minimum height to accommodate the lift of the locking pin.

With a locomotive not having a buffer coupled to a passenger car having a buffer, the passenger-car buffer at rest will extend from 2½ in. to 3½ in. (varying with standard platforms) back of the coupling or pulling face of the locomotive coupler, and with the draft gear of the car completely compressed (2½ in.), the buffer on the passenger car will then extend 5 in. to 6 in. back of the coupling or pulling face of the locomotive coupler, plus any slack in the contour lines, therefore, the minimum height of coupler head should extend about 6 in. back from the coupling point.

Since it is desirable to use the same coupler head on locomotives and freight cars, it is seen that the height of head for freight cars is limited by and should be designed to accommodate a condition of a locomotive coupling to a passenger car, in order to avoid the necessity of off-setting the coupler head below center line of coupler shank for use on locomotives, which would not be very undesirable, since locomotive couplers are subjected to the most severe strains.

The data collected and the entire situation was gone over and the following unsettled points decided upon:

1. The hub of the knuckle shall be 8 in. high.
2. The height of the coupler head above center line of coupler shank shall not exceed:

A—Locomotive Coupler: 6¾ in. for a distance of 6 in. back of coupling line.

B—Freight Car Coupler: 9¼ in. for a distance of 6 in. back of coupling line, but using same head as for locomotive coupler, the allowable increase (½ in.) in height for the freight car coupler is to provide for reinforcement of junction of top coupler ear to coupler head.

3. The head shall not be offset below center line of coupler shank.
4. The design of the coupler shank shall be the same in both experimental couplers; to be decided soon at a conference between the two coupler manufacturers and your chairman.
5. The weight of the complete couplers, 6 by 8 in. shank, 9⅛ in. butt, shall not exceed 400 lb.

COUPLER SHANK, BUTT END AND KEY SLOT.

A meeting of representatives of coupler committee, American Steel Foundries and the National Malleable Castings Company, was held at Alliance, Ohio, October 13, 1913, with the view of discussing the design of coupler shank, coupler butt and key slot, with the following results:

Coupler Shank, 6 by 8 in.: The design of coupler shank as shown on American Steel Foundries drawing 03401, dated October 8, 1913, was accepted for the present. This includes thickness of the walls, the juncture of the shank to head and liner block. The National Malleable Castings Company's drawings 11974, dated April 10, 1913; 11977, dated April 9, 1913, and 11971, dated April 8, 1913, were accepted for the present. These include the thickness of the walls, the juncture of the shank to the head and liner block.

Coupler Butt: The coupler butt to be 9⅛ in., with 1¼ in. vertical face for yoke gib. The coupler rivet holes and general design of butt the same as present M. C. B. Standard.

Key Slot: The key slot was discussed at length and it was decided that a uniform standard should be adopted. The different forms of key attachments at present used specify various designs of key slots, and in order to arrive at a uniform standard the chairman agreed to take this subject up with the various parties interested and make such tests as may be necessary to determine the design and dimension of key slot that should be recommended.

Coupler Shank, 5 by 7 in.: The shank to be the same as at present M. C. B. Standard, with the exception of the juncture of the shank to the head, which is to be in accordance with drawings submitted for the representative couplers.

Coupler Butt: Same as present M. C. B. Standard.

Key Slot: Same as M. C. B. Standard.

KNUCKLE CONTOURS.

Having apparently settled all details or questions of dimensions, designs, etc., the manufacturers of the two experimental standard M. C. B. Couplers were thus enabled to rush the metal patterns of same to completion and hence be in a position to fill orders for same and get the couplers into service as quickly as possible, which was desirable in order that some results would be available for the 1914 convention.

The difference of the knuckle contours of the types "A" and "B" knuckles of No. 5 contour where it diverges from the contour of the coupler body having been brought to the attention of the two manufacturers, and the American Steel Foundries having objected to the "B" knuckle of No. 5 contour, a meeting was called for the purpose of settling this question and to inaugurate a series of tests of the two experimental standard M. C. B. Couplers on the service-testing

machine at the Alliance works of the American Steel Foundries.

It was agreed that the "A" knuckle of No. 5 contour is slightly more desirable for coupling operations and the "B" knuckle of No. 5 contour is somewhat better for uncoupling operations, but since the effect of these differences in the steel specimens are slight, the manufacturers shall continue to furnish the knuckle-tail contours as at present, with the final shape to be determined by the service trials.

TESTS OF "A" AND "B" COUPLERS ON SERVICE-TESTING MACHINE.

These tests were inaugurated on a machine at the Alliance works of the American Steel Foundries at the joint conference held there on January 7, 1914, primarily to try out the knuckle contours for coupling and uncoupling, but particularly to test the lasting qualities and efficiency of the operating parts, learn the location, extent and effect of wear of same and ascertain if any changes, however slight, are necessary or desirable in the couplers.

Two type "A" couplers of No. 5 contour were tested together and two type "B" couplers of No. 5 contour were tested together. Each of these tests were run through 30,000 cycles, each of which, as described above, consisted of the following operations for the lower or operating coupler: coupling, lock-setting, uncoupling by withdrawing from outer couplers, knuckle pushed to closed position by a lever, then knuckle thrown completely open by uncoupling rod. Assuming a freight-car coupler in service will average daily (365 days to a year) the operations here listed as one cycle, these tests each represent 82 years' wear, disregarding effect on operating parts due to strains received in regular service.

The results of the tests were very satisfactory and favorable to both couplers. The operating parts naturally were considerably worn, but after each test the couplers were operative in all features with scarcely any impairment of efficiency. New parts were substituted for the worn parts, trying out all combinations, and it was found that the couplers were fully operative. Some minor changes were shown to be desirable and these have been made. This was a very severe test and the committee is firm in the belief that not any of the present standard couplers in general use today would meet it.

The committee believes it desirable for the Association to have a uniform stenciling for freight cars equipped with the experimental standard M. C. B. couplers so that they can be manipulated and readily identified by all car inspectors and repairmen, thereby schooling the latter and others in line with the adoption of the standard M. C. B. coupler, as well as assist the committee during the trial period. The stenciling should designate between the types (A or B) and between the contours (No. 5 or No. 10), and it would recommend the adoption of stenciling as follows, which is the same as the marking cast on the couplers:

"A 5" E. S.-M. C. B. Coupler.
"A 10" E. S.-M. C. B. Coupler.
"B 5" E. S.-M. C. B. Coupler.
"B 10" E. S.-M. C. B. Coupler.

There are, unavoidably, patents involved in both types "A" and "B" experimental standard M. C. B. couplers, and they were, on April 6, 1914, submitted to ascertain the scope and validity of same. When this report is received the matter will be referred to the executive committee.

PROGRAM OF TESTS FOR ENSUING YEAR.

After the close of the convention the following tests of the A and B couplers will be conducted under the direct supervision of the committee:

Dynamic and static.
Angling and coupling.
Jiggling and lock-creeping.
Service-machine.

Discussion.

The report of the committee was accepted and the committee continued.

SAFETY APPLIANCES.

M. K. Barnum, the chairman of this committee, stated that a circular has been sent out asking for certain information but that the replies were hardly complete enough to justify a formal report. The committee had come to the conclusion that there was need of more activity in the work of applying safety appliances. The committee made the point that efforts should be made to instruct the car men with regard to the proper application of safety appliances.

Discussion.

T. H. Goodnow: When the law becomes effective in 1916 there will be differences of opinion in the interchange of cars. Would it not be a good idea to district off the country and put each district in charge of a man competent to instruct men with regard to standardizing safety appliances.

J. J. Hennessey: I believe this Association should get out a set of illustrations and send it out to every railroad.

F. W. Brazier: We are getting up a book, and are going to have illustrations and the law in it. We also have five men going over the system to educate our men.

E. W. Pratt: I believe this committee was to look up the matter of printing a pamphlet on safety appliances.

M. K. Barnum: The committee has been working on that proposition and an M. C. B. book of safety appliances will be sent out in the near future.

The report of the committee was accepted.

LOADING RULES.

The committee recommended the following changes:

The last sentence of Rule 15-E, as appearing in the 1913 printed code, was presented in the committee's supplementary report, but through error was not included in the letter ballot. As the provision of the clause does not seem to be exactly what is desirable, the committee recommends that it be withdrawn pending further investigation.

RECOMMENDED CHANGES.

Page 3, heading.—Omit the words "On open cars."

Reference to height of dividing line between high and low side gondola cars should be shown as 36 in. instead of 30 in. throughout the code when reprinted.

Rule 8.—Add a new sentence as follows: "The lading must be so placed on the car that there will not be more weight on one side of the car than on the other."

Rule 12, seventh line.—Change "Rule 32, Fig. 4," to read "Rules 32, 33 and 34, Figs. 4 and 4-a."

Rule 15.—Add the following to the end of the first paragraph:

"Wooden flat cars having but two truss rods must not be used for twin or triple loads."

Rule 15-A.—Omit reference to flat cars with two truss rods.

Add to the end of rule "On steel flat and steel drop-end gondola cars constructed with fish-belly girders, the weight of lading must not exceed three-quarters (¾) of the capacity of car."

Rule 15-B.—Omit reference to flat cars with two truss rods.

Rule 22.—Insert "Or sliding pieces," in first line after words "bearing-pieces." The height of sliding-pieces should be limited as well as bearing-pieces.

Change last sentence in rule to read as follows:

"For structural material the bearing-pieces must be securely fastened to the floor of car as per Rule 72. For lumber, logs, telegraph poles, piling and props, on open cars loaded as per Figs. 6, 8, 9, 10 and 11, the bearing-pieces must be securely held in place by cleats as per **Fig. 1.**

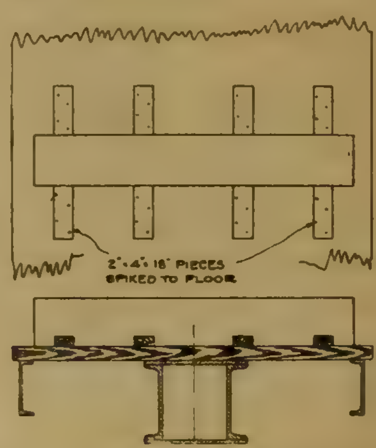


Fig. 1—Blocking Bearing Piece for Lumber, Logs, Etc.

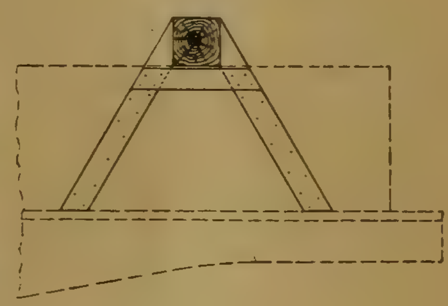


Fig. 2—Bracing for Bearing Pieces.

Rule 23.—In first line change "and" to "or." The rule is intended to limit the location of sliding-pieces as well as bearing-pieces.

Rule 72.—Change the word "blocks" in second and fifth lines to "pieces."

Rule 78.—Change to read "Clamping pieces on top of load," instead of "on top of sides of cars," as the clamping-pieces are always placed on the load and not on car sides.

Figs. 32, 33, 44 and 45.—Change the fish-tail brace for bearing-pieces to angular braces, as per Fig. 2.

Rule 81-D.—Fifth line, page 71, should be changed to read: "Three or more vertical straight-grain hardwood posts;" also there should be shown on cut 33-B, 2 by 6-in. hardwood timbers securely bolted between upright posts and side of car and extend 6 in. above top of lading to prevent lading shifting sidewise.

Rule 82, first paragraph, third line.—Change words "bearing-piece" to "sliding-piece." Sliding-pieces are intended.

Fig. 34.—Change to read: "Must not exceed 65 ft." Also add to first line of note under figure "box girders, columns, one-half roof trusses and similar material."

Figs. 43-A and 43-B.—Sliding-pieces should not be shown outside of bolsters toward end of car, as this location is prohibited by Rule 23.

Rule 91.—Change to read: "When gondola cars are used for twin loads a clearance of at least eighteen (18) in. on each side between the load and car sides and end-gate stops at narrowest point; and when used for continuous triple loads at least thirty-nine (39) in. must be provided for curving." See Fig. 12; also change Fig. 12 to conform to new rule.

Also add a note to rule, reading as follows:

"NOTE.—As the specified clearances are to take care of road rather than terminal conditions, precautions should be exercised at terminals where short curves exist to prevent damage to sides of cars."

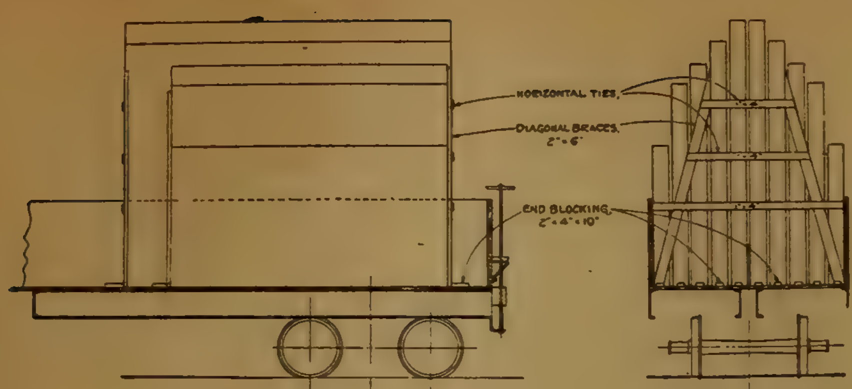


Fig. 3—Manner of Loading Plate Glass.

Rule 93, page 85.—Change "22 in." in fourth line to "18 in." To making sliding-irons conform to clearance limits.

Rule 98.—The last sentence should be changed to read as follows: "Rolling freight must be loaded longitudinally with car and must be chocked to prevent side motion. Substantial blocking should be placed across end of car at end of load to prevent end of car being cut by material shifting endwise."

Rule 117-C.—Change blocking on Fig. 61-A from "6 in. by 6 in." to "2 in. by 2 in."

Fig. 64-D.—Change angular chocking from "8 in. by 10 in. by 24 in." to "not less than 6 in. by 8 in. by 16 in."

The following rule should be added to the code to cover shipments of derrick cars and similar machinery having swinging booms:

"Rule 121-C.—Derrick cars, and similar machinery when shipped on their own wheels or otherwise, the swinging booms must be substantially secured to prevent swinging in transit."

Rule 122.—Change heading to read: "Rules Governing Loading of Plate Glass on Flat or Gondola Cars."

Add a new paragraph to Rule 122, as follows:

"When a number of boxes containing plate glass are loaded on gondola or flat cars they should be loaded vertically, one tightly against the other with one end of all boxes flush, and blocked along the side of outside boxes at both ends of each box on floor of car with not less than two (2) by four (4) in. blocks, ten (10) in. long. Diagonal braces of not less than two (2) by six (6) in., securely nailed at top of outside boxes, and braced and cleated at bottom to sides or floor of car to prevent shifting, should be used. Three horizontal ties not less than one (1) by four (4) in. should be securely nailed to the diagonal braces and ends of boxes where they are flush. At opposite end diagonal braces, not less than two (2) by six (6) in. should be used to brace each set of boxes of the same length, or each box if of different lengths. See Fig. 3."

Rule 123-A.—Change first line to read: "Iron ore, limestone and similar heavy materials, transported."

Page 135. Note under heading.—Change to read: "The agent or inspector at the loading point must see that the rules for loading material in closed cars are strictly enforced. Where opportunity is provided, the lading should be inspected in transit."

Rule 124.—Add a sentence to the end of rule reading as follows: "The lading must be so placed in the car that there will not be more weight on one side of the car than on the other."

Add a new paragraph reading as follows: "When necessary to nail cleats or braces to lining of box cars having steel superstructure without exterior siding, the nails must not be driven entirely through the lining."

A new rule reading as follows should be added to the code:

"Rule 124-A.—Brick 15 in. and less in length loaded crosswise at doorway do not require door protection if built up as per Fig. 4. Brick of any length loaded lengthwise at doorway must have door protection as per Fig. 5."

It has been suggested that the following paragraph be added to this rule:

"Cost of applying door protection should be charged to the originating line, whether discovered at the time of interchange, or in transit."

The committee believes that the improper loading of closed cars should be taken care of by the originating line, but does not believe this comes within the scope of its work. The committee thinks the suggestion should be referred to the A. R. A.

Rule 131.—Should be changed to read as follows: "When material loaded in stock cars is liable to work through the space between the slats, these spaces must be sufficiently sealed to prevent loss of material, or ends of material working through the spaces."

Rule 132.—In the first line, after the word "pipe," omit words "drain tile." After word "separated," in second line, change to read "by not less than ½ by 2 in. hardwood strips."

A new rule covering the manner of loading drain tile, reading as follows, should be added to code:

"Rule 132-A.—Drain tile loaded in closed cars. Tile 8 in. in diameter and under should be loaded in tiers as per Fig. 6 (see Rule 130 for required door protection). Tile 10 in. to 28 in., inclusive, in diameter, should be loaded as per Fig. 7, and 30 in. in diameter and over should be loaded as per Fig. 8."

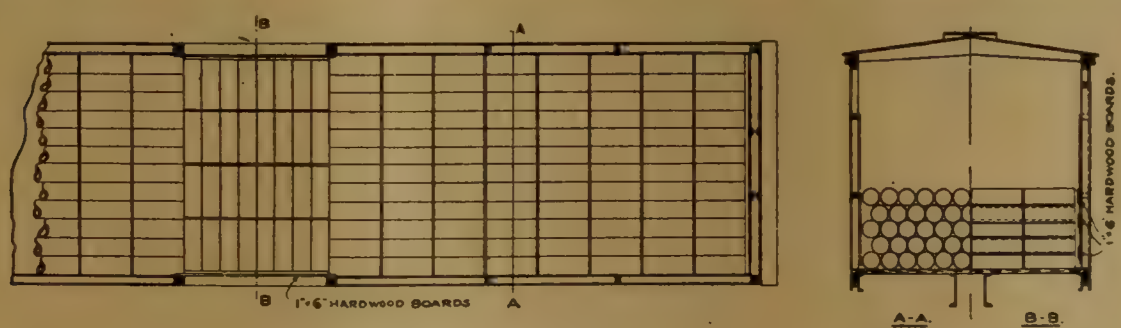


Fig. 6—Manner of Loading.

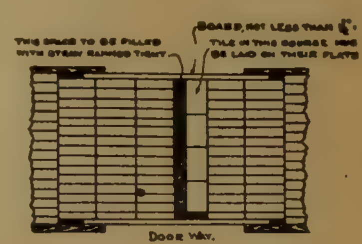


Fig. 5—Manner of Loading Brick When Door Protection Is Required.

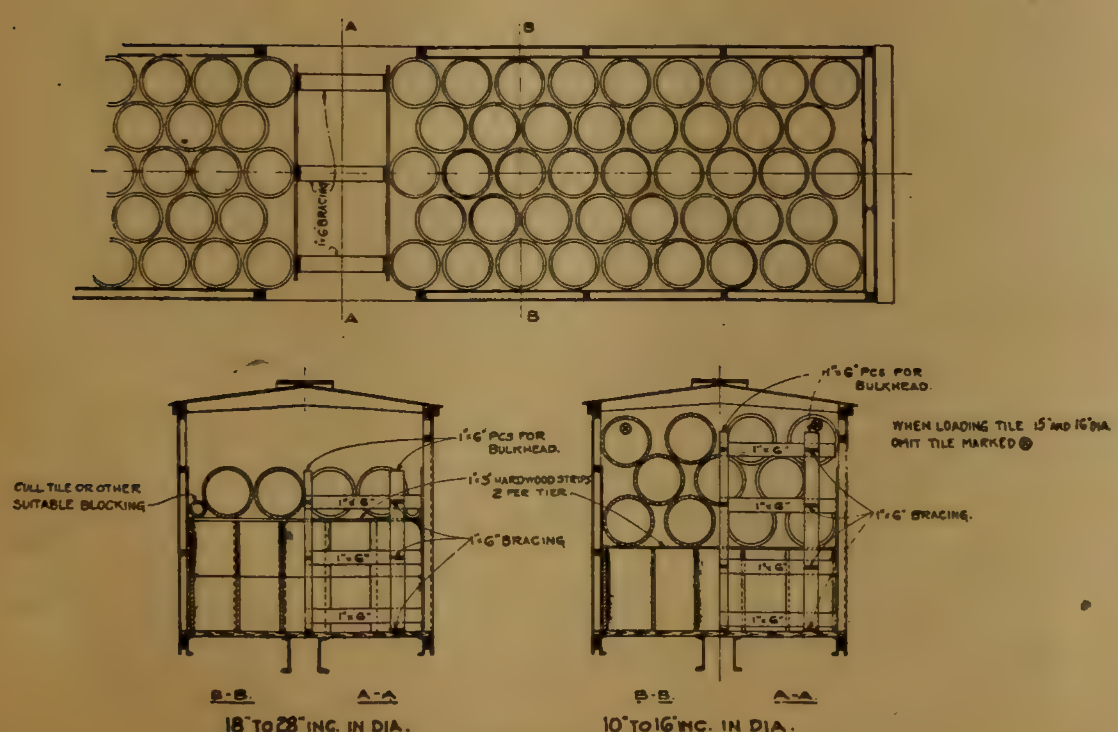


Fig. 7—Manner of Loading Drain Tile 10" to 28" in Diameter.

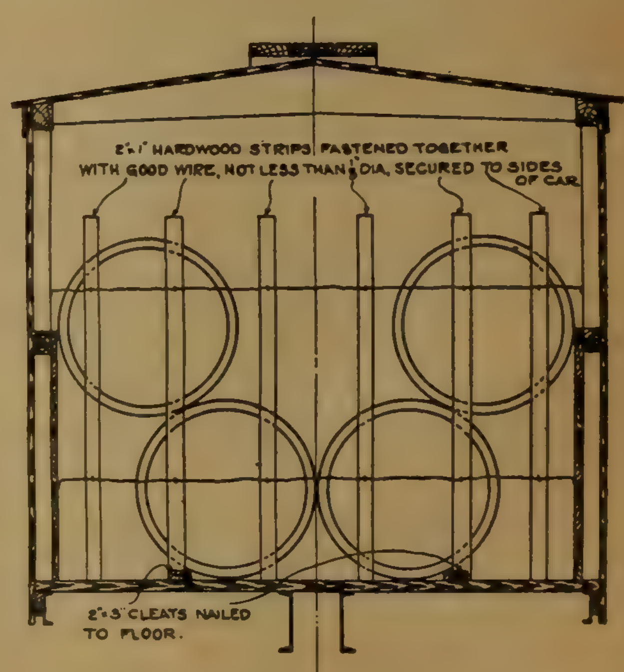


Fig. 8—Manner of Loading Drain Tile 30" in Diameter and Over.

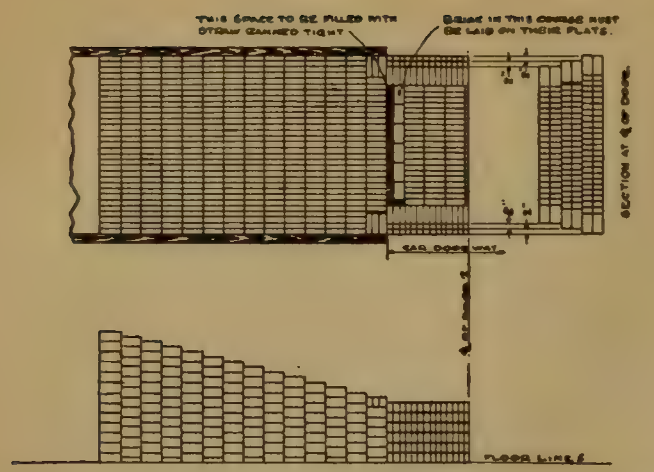


Fig. 4—Manner of Loading Brick 15" and Less in Length.

Rule 133.—Fourth line, after the word "aft," insert the following:

"Machinery resting on legs should be securely braced and propped at ends in addition to the floor strips to prevent breakage by shifting."

COMMITTEE:—A. KEARNEY, (chairman); L. H. TURNER, J. M. BORROWDALE, C. N. SWANSON, G. H. GILMAN, A. B. CORINTH and R. L. KLEINE.

After reading the report, Chairman Kearney added two other changes as follows: In the paragraph on End Protection in Rule 118 it should read: "3 in. by 4 in. strips," instead of "4 in. by 4 in.," and in the second paragraph of Rule 119-C it should read: "3 in. by 4 in. strips," instead of "4 in. by 4 in."

Discussion.

S. Lynn: We do not need more rules but we do need some way of forcing shippers to live up to the rules we have. When you try to enforce the rules with some shippers they will say that if you do not want to take the load as it is, some other line will.

D. R. MacBain: We have trouble on some of our trains with doors bulging out and I think that we should interest the American Railway Association in forcing the observation of these loading rules.

The committee report was accepted and referred to letter ballot.

OVERHEAD INSPECTION OF BOX CARS.

Following the procedure indicated last June, the committee, when it was called upon by the American Railway Association sub-committee, explained to them in detail the code of rules for the overhead inspection of box cars, formulated at their suggestion. The proposed code was gone over with the American Railway Association committee, studied at length, and several changes were made, without, however, disturbing its general plan or principle. The code as finally accepted by the American Railway Association committee was submitted to the executive committee of that Association, and was later laid before the American Railway Association at their semi-annual conference, held in Chicago, November last.

The card and code of instructions as finally accepted by the American Railway Association as a recommended practice, are as follows:

INSPECTION AND CERTIFICATION OF BOX CARS BEFORE LOADING WITH FREIGHT SUBJECT TO DAMAGE.

(Recommended Practice subject to such changes as may be required to meet local or special conditions.)

NOTE.—This inspection does not cover cars for explosives or other dangerous articles provided for by the Regulations of the Bureau of Explosives.

Freight as described below must be loaded in certified cars which have received a special inspection in accordance with the following instructions:

If cars pass the special inspection, this will be indicated by an inspection certificate which will be tacked on each side of the car below the car number.

CLASSIFICATION OF EQUIPMENT SUITABLE FOR THE FOLLOWING FREIGHT.

Classification "A."—Package freight liable to loss or damage by water, protruding nails, material carrying odors, oil, grease, or moisture on interior of car, especially the floor.

Classification "B."—Bulk freight liable to damage by water or to loss through small openings.

Classification "C."—Freight liable to loss or damage by water or protruding nails, but which can not be lost through small openings.

The face of inspection certificate should be printed as follows:

INSPECTION CERTIFICATE.

NORTH AND SOUTH RAILROAD.

Car Initial.................. No.........

O. K. for shipment of commodities.

Under

Classification

Inspected by........................

Date..........19...... Station.............

On back of card, inspection instructions should be printed as follows:

INSPECT FOR

and see that car is free from following defects:

Classification "A."	*Classification "B."*	*Classification "C."*
Leaky roof.	Leaky roof.	Leaky roof.
Loose siding.	Loose siding.	Loose siding.
Loose roof boards.	Loose roof boards.	Loose roof boards.
Shifted roof sheets.	Shifted roof sheets.	Shifted roof sheets.
Broken door stops.	Broken door stops.	Broken door stops.
Leaky doors, tops and sides.	Leaky doors, tops and sides.	Leaky doors, tops and sides.
Broken end posts.	Broken end posts.	Broken end posts.
Broken or loose door posts.	Broken or loose door posts.	Broken or loose door posts.
Protruding nails in floor and lining.	Holes in floor and around center plate and draft bolts.	Protruding nails in floor and lining.
Floors or sides soiled by oil, grease or any material carrying odors likely to damage lading.		

(A) When there are inspectors located at points of loading the inspection will be made and certificates attached at that point.

(B) Where inspectors are located at a point from which empty cars are distributed to stations the inspection will be made and certificates attached at that point. This inspection will be confirmed by agent at loading point.

(C) In all other cases the agent at loading point should inspect the car and file certificates as below.

Aside from the Master Car Builders' inspection of car, including roof, running boards, air brakes, safety appliances and running gear, as well as the external inspection of sides, ends, doors, ventilators and windows, before inspection certificate is issued, an internal inspection must be made.

1. Search for loose, damaged and broken boards, loose knots, knot holes, bad joints, etc.
2. Search for all nails, spikes, screws and bolts extending above surface of floor and lining and nails protruding through roofing.
3. Search for water stains indicating cracks and air spaces.
4. Examine for metal sheets out of position along edge of sub-car line or down from edge of ridge pole.
5. Doors must open and close properly.
6. Inspect closely for defects in framing which might, by reason of their weakness, allow the sheathing to readily be broken or damaged.

Close doors, ventilators, and windows and

7. Search of light indicating openings and cracks which might produce leaks.
8. Search for cracks sufficient to admit storm water beating through opening; also for openings and bad joints around windows and doors.

When a car is loaded by a shipper the inspection certificates must be detached from the car and delivered to agent before bill of lading is issued. All certificates finally must be filed by the agent at point of loading for future reference.

Committee:—A. KEARNEY, (chairman); L. H. TURNER, C. N. SWANSON, J. M. BARROWDALE, G. H. GILMAN, A. B. CORINTH, R. L. KLEINE.

The report was accepted and the committee continued.

INTERLINE LOADING OF COMMODITIES.

The establishment of a uniform code of rules for the interline loading of commodities, a subject referred to the committee for investigation, was received rather late in the year; indeed too late to permit the research it evidently requires. Hence the committee is only able at this time to offer a report of progress, with the assurance that an effort is being made to ascertain what seems to be necessary to satisfactorily meet the requirements.

The committee frankly confesses it does not yet have a very clear conception of what is embraced in the question; at the same time it appreciates that there does not seem to be any doubt that a higher efficiency may be assured, and less loss experienced by more securely loading and packing commodities handled in interline shipments. What might be accomplished in that direction, however, is as yet uncertain.

Due to the short time the committee has had the subject in hand, opportunity has been lacking to secure information of any particular interest. Furthermore, it has not been able to confer with the subcommittee of the American Railway Association on marking, packing and handling of freight, nor with the patron of the suggestion, in conference with whom it is believed a better plan of investigation and course of procedure may be outlined.

It is therefore the intention of the committee to go into this matter carefully during the coming year.

Committee: A. KEARNEY (chairman), L. H. TURNER, C. N. SWANSON, J. M. BARROWDALE, G. H. GILMAN, A. B. CORINTH, R. L. KLEINE.

TRAIN LIGHTING.

In last year's report the committee recommended designs for standard pulley seats for application of axle pulleys, the designs being incorporated on exhibit showing M. C. B. standard 4¼ by 8 in. and 5 by 9 in. axles. This recommendation was rejected.

The committee feels that most of the objections were due to the fact that the mechanical men of the railroads did not feel it desirable to operate with straight axles or with axles with a straight pulley fit.

However, there are a number of railroads which are using straight axles and axles with straight pulley fit, and, as stated by your committee last year, it was felt that a design of axle used on any road should meet the approval of the mechanical men of the road. The committee's recommendation was with a view of standardizing the size of pulley seats for straight and tapered axles, thus making possible the use of interchangeable bushings, which will materially facilitate the handling of electric-lighted cars.

The extension of axle-lighting devices has demonstrated the necessity for standardizing the size of pulley seats not only from a standpoint of convenience in interchangeability, but from a standpoint of safety to equipment and economy in operation. The committee is therefore still of the opinion that the association should approve as recommended practice the following:

PULLEY SEATS FOR TAPERED OR STRAIGHT AXLES.

The dimensions of axles at the point of pulley fit shall be in accordance with the dimensions shown on Exhibit "B."

In last year's report the committee recommended standard dimensions for the inside of battery boxes. This recommendation was rejected on letter ballot, principally for the reason that the dimensions as given did not conform to the detail dimensions used by the various railroads. It was naturally impossible for the committee to recommend dimensions which would fit all of the standard battery boxes in existence, and it was the endeavor to recommend dimensions which represented the average practice of the roads. The committee feels that the M. C. B. Association should standardize the inside dimension of battery boxes for future construction, and again submit their recommendations to the M. C. B. Association, as follows:

The inside clear dimension of battery boxes should be as follows:

Depth, front to back, 2 ft. 4 in.

Height in clear, not less than 21½ in.

Length of compartment for two standard double-compartment tanks or equivalent, 22⅝ in.

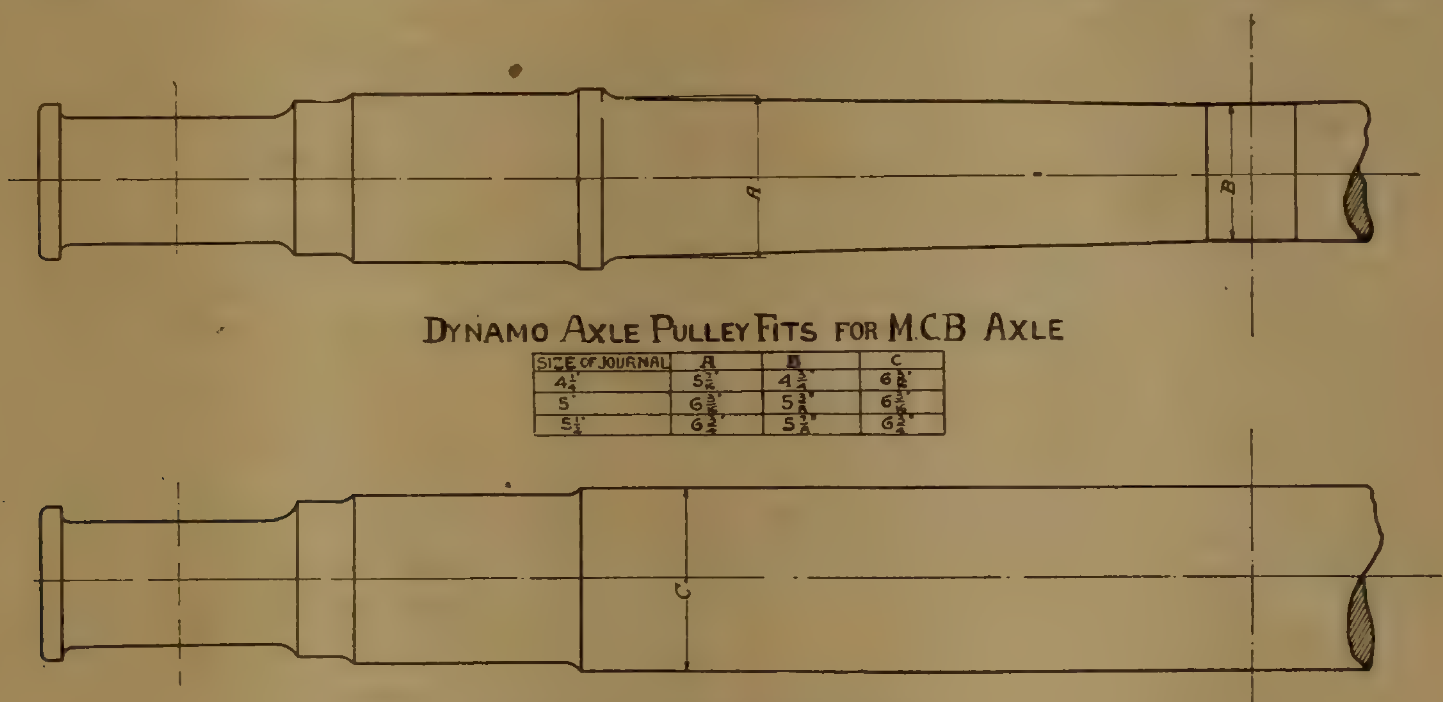


Fig. 1—Axle Dimensions for Pulley Fit.

Length of compartment for four standard double-compartment tanks or equivalent, 3 ft. 9¼ in.

At last year's convention the committee recommended that the battery-box tray be reinforced by safety angle irons or straps. This recommendation was not accepted on letter ballot, due to the fact that a number of roads were of the opinion that a battery box properly designed for the weight it should carry and properly maintained had a sufficient factor of safety. The committee feels that the liability of battery trays dropping down on the track is a sufficient hazard to justify the installation of safety irons or angles and again submit their recommendations as follows:

That in all battery-box designs, two angle irons or straps shall extend longitudinally under the battery box in such a location that in case of a defective battery-box floor the battery trays will be supported by the said angle irons or straps; the angle irons or straps shall be supported to the car body independent of the battery box proper and shall be of sufficient strength in all parts to safely support the battery in accordance with the weight shown in paragraph 8 and the additional weight of the battery box proper, and the angle irons or straps and the supports for same shall be so installed that they can be readily inspected for corrosion.

On Sheet U-9, recommended practice adopted in 1912, is shown a G 18½ bulb with a base longer than the standard base. This was recommended in 1912 on account of the fact that the design of the fixtures in quite a number of car-lighting equipments was such as to require an extra length of base. The majority of roads owning such cars have modified their fixtures so as to accommodate the standard G 18½ bulb, and the committee recommends as follows:

The cut of the G 18½ bulb, as shown on Recommended Practice Sheet U-9, be changed to have an over-all length of 3⅝ in. plus or minus ⅛ in. and a width of 2 5-16 in. plus or minus 1-32 in.

PULLEY FIT FOR AXLE-GENERATOR SHAFTS AND AXLE-GENERATOR PULLEYS.

The committee has given considerable attention to the question of standard pulley fit for axle-generator shafts and standard generator pulleys. There are in service at present generator shafts with a variety of pulley fits, and also a large number of different designs of pulleys. These variations are the cause of an unnecessary expense in the maintenance of electric car-lighting apparatus, and with a view to standardizing these fixtures your committee would recommend that it be continued and that it be authorized to confer with a committee of manufacturers of car-lighting devices and a committee of the Association of Railway Electric Engineers, with a view to reaching final conclusions so that designs may be submitted to the association as recommended practice.

Committee: T. R. Cook (chairman), C. A. Brandt, Ward Barnum, D. J. Cartwright, E. W. Jansen, J. H. Davis, C. H. Quinn.

Discussion.

E. W. Pratt: I move that the recommendations be submitted to letter ballot and that the committee confer with the manufacturers as suggested.

This motion was carried.

TANK CARS.

During the past year comparatively few questions have been put to the tank car committee. Probably the most important question presented to the committee has been the question of the continued use in transportation service of the old tanks, originally on wooden underframes.

The committee held a joint meeting January 6, 1914, with the Bureau of Explosives of the American Railway Association, as well as with a number of owners of tank cars. The general question was whether old tanks transferred to new steel underframes should not be put on the same basis as tank cars built after 1913, viz., required to stand the 60-lb. test pressure. Some of the owners considered that this would be an unnecessary hardship, and proposals were even made to lower the test pressure to 20 lb. Following the meeting yard tests were made of an old condemned tank, from which the conclusion was drawn that a tank which would stand 20-lb. water pressure without leaking would withstand the shock acquired in transportation when filled with a liquid of the same viscosity as water. Notwithstanding this, the committee feels that it is unwise to permit the unrestricted transfer of old tanks to steel underframes, especially where they are to carry inflammables such as the gasolines. Tanks are running which are known to be more than thirty-five years old, and as the tank car specification has been in existence ten years, it would seem that any tank on wooden underframe has already given a reasonable life. Recognizing the fact, however, that many of the tanks originally on wooden underframes may have been well designed and constructed, their use should be allowed if they will stand the test required of tanks built since 1903.

The committee feels also that there should be a distinction between cars carrying inflammables and those carrying other products not involving the safety question; that the interval between the hydraulic tests should be shorter as the age of the tank increases; that definite provision should be made in the specification for the retirement from transportation service of tanks which cannot meet the test requirements.

Another point which has been called to the attention of the committee is that in many cases the pressure tests have not been made by filling the tanks with cold water as prescribed, in some cases air

pressure having been used, or hot water, or even steam. The committee does not feel that such tests meet the spirit of the specification, and do not insure the detection of the leaks to the same extent that the cold-water pressure will do.

The attention of the committee has also been called to certain unsatisfactory features in the construction of tanks, such as improper rivet spacing, caulking, etc., but it is hoped that the proper application of the prescribed tests will lead to a correction of these faults, without it being necessary to prescribe the details of construction.

To cover the several points already discussed in the report, the committee recommends the following amendments of the 1913 specifications for tank cars:

That a new paragraph be added under general requirements (page 2), as follows:

"(d) Tanks which do not meet the prescribed tests shall be withdrawn from transportation service."

That Section 5, Test of Specifications for Ordinary Tank Cars, be amended to read as follows, the present wording being given for comparison:

"Tanks must be carefully inspected and tested before being put into service, again at an interval of ten years, and after that at intervals of not over five years; with the exception that where tanks are used for carrying corrosive products, deterioration is to be expected in a shorter time, and the first test period shall then be reduced to five years. Tanks requiring this five-year test shall be those used for carrying chemicals, such as acids, ammonia liquors, and such other products as hereafter may be specified.

"Provided, that any tank damaged to the extent of requiring renewal of sheet, or extensive reriveting or recaulking of seams, shall be retested before being returned to service.

"All tests shall be made by completely filling the tank with water of a temperature which shall not exceed 70 deg. F. during test. The prescribed pressure must be held for not less than ten minutes after the tank has been caulked tight, and may be applied in any suitable manner.

"The tests for tanks built prior to 1903 shall be at 40 lb. per sq. in., and for tanks built since that date at 60 lb. per sq.in., which they must stand without leak or evidence of distress.

"After January 1, 1915, all tanks tested to less than 60-lb. pressure shall be stenciled 'Not to be used for liquids requiring the inflammable placards under the I. C. C. regulations.'

"After January 1, 1918, all tanks in transportation service shall be subjected to the full test requirements of 60 lb. per sq. in.

"Tanks when tested must be stenciled with the date, pressure at which tested, place where test was made, and by whom, as follows:

"Tested (date) ....
"Pressure (lb. per sq. in.) ....
"At (place) ....
"By (name of firm) ....

"The tank-car owner shall be responsible for the proper carrying out of all inspections and tests and stenciling, and for the certification of the tests to the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles (see Section 8)."

That Section 7, Test of Safety Valves, Specifications for Ordinary Tank Cars, be amended to read as follows:

"Safety valves must be tested and adjusted if necessary (a) on new cars, before the cars are put in service; (b) on existing cars, by January 1, 1916; and thereafter on all cars at intervals of not over two years.

"When valves are tested, the date, pressure to which tested, place where test was made, and by whom, must be stenciled on the body of the tank, near the end and adjacent to the stenciling for test of tank, as follows:

"Tested (date) ....
"Pressure (lb. per sq. in.) ....
"At (place) ....
"By (name of firm) ....

"In addition to stenciling on body of car, there shall be stamped on body of valve, in ¼ or ⅜ in. figures, the date of test and pounds pressure to which valve was tested. Date of test on tank and last date on valve must correspond.

"The test may be made without the removal of the valve from the car, provided the valve unseats at a total pressure corresponding with the area of the seat multiplied by the required pressure.

"Valves improperly set, or not tested and stenciled at proper intervals, shall constitute defects for which the owner shall be responsible.

"The tank-car owner shall be responsible for certification of tests to the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles (see Section 8)."

That a new paragraph be added following Section 7, as follows, the remaining sections to be renumbered accordingly:

"8. Certification of Tests.—Certificates of all tests of tanks and their safety valves shall be sent to the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, in such form as may be prescribed by the Bureau."

Committee: A. W. Gibbs (chairman), C. E. Chambers, J. W. Fogg, Thos. Beaghen, Jr., Wm. Schlafge, C. A. Shoemaker.

Discussion.

A. W. Gibbs: Many tank cars today have poor discharge valves which give a great deal of trouble from leakage. We wish to urge on the owners that this receive more attention.

R. E. Smith: Has not the question of stenciling light weight on the tank cars been taken up recently?

A. W. Gibbs: The General Managers' Association of the Southeast has been urging it for some time past.

J. J. Hennessey: I move that the report be accepted and referred to letter ballot.

This motion was carried.

CAR TRUCKS.

The following subjects were assigned by the executive committee to the committee on car trucks and were discussed in the report of the committee to the convention last year (see M. C. B. Proceedings, 1913, pages 503 to 507, inclusive), outlining the work to be done during the ensuing year, viz.:

1. Submit limiting dimensions for cast steel truck sides for 80,000, 100,000 and 140,000 pounds capacity cars and revise specifications covering same.
2. Submit design for cast steel truck bolsters for 80,000, 100,000 and 140,000 pounds capacity cars and revise specifications covering same.
3. Spread of side bearings, center to center, on various capacity cars from 60,000 to 100,000 pounds.
4. Clearance of side bearings.
5. Construction of center plates for standard freight cars.
6. Spring for trucks.
7. Strength of arch bar trucks as compared with cast steel truck sides.

LIMITING DIMENSIONS AND REVISION OF SPECIFICATIONS.

On account of cast steel truck sides being generally covered by letters patent it was decided impracticable to recommend definite designs, but as the association has directed the committee to submit standard designs of truck bolsters it becomes necessary to adopt limiting dimensions for the truck sides to provide for the application of the standard truck bolsters and interchangeability. The strength of the acceptable cast steel truck sides for the various capacity cars is taken care of by the specifications and tests, which will eliminate those of weaker design, thus establishing a standard for cast steel truck sides without definitely prescribing the design.

The manufacturers of cast steel truck sides were requested to submit drawings of the different truck sides manufactured by them with a view of arriving at the limiting dimensions for truck sides. To establish limiting dimensions the committee was governed by the following:

The height from top of rail to top of truck bolster (underside of truck center plate) was fixed at 26⅞ inches with empty cars for all capacities.

The vertical height from the bearing surface of the truck center plate to top of spring cap (or underside of bolster resting on spring cap) was fixed at 8¾ inches for all capacities. This dimension is correlated to the maximum height of side frame from rail, which latter was established at 31 inches, due to limitations of body car construction.

The vertical height from the top of spring cap (or underside of bolster), to top of side frame is dependent upon the capacity.

A uniform spring height is maintained for the three capacity trucks and all springs can be built up from the same unit coils. This establishes the height from top of spring plank (or bottom of lower spring cap) to top of rail, or 10½ inches.

A minimum distance of 4 inches is necessary as a safe clearance between bottom of side frame and top of rail with new wheels, bearings, etc., leaving 6½ inches as a maximum total for thickness of spring plank and depth of bottom member of side frame, which latter is determined by design and capacity desired.

The widths of bolster openings are governed by the capacity and the width of spring base required, which also controls the wheel base.

The cross section of the top and bottom members of the truck side is determined from the capacity and governed by allowable stresses for members made of cast steel and controlled by the specifications and tests.

The limiting dimensions shown (Fig. 1) for the 80,000 pounds, 100,000 pounds and 140,000 pounds cast steel truck sides were established on the foregoing basis and are submitted for approval.

Specifications and Tests.—The committee recommends the following changes and additions in the present recommended practice:

Under Article III, Physical Properties and Tests, after Section 10. Physical Properties, add new section for proof test, as follows:

Proof Test.—Each truck side shall be tested in a suitable machine to the loads shown in the table for different capacity trucks.

Car Capacity, Pounds.	Initial Load, Pounds.	Proof Tests: Load, Pounds.	Maximum Deflection, Inches.	Maximum Set, Inches.
80,000	20,000	110,000	0.15	0.01
100,000	25,000	125,000	0.15	0.01
140,000	35,000	175,000	0.15	0.01

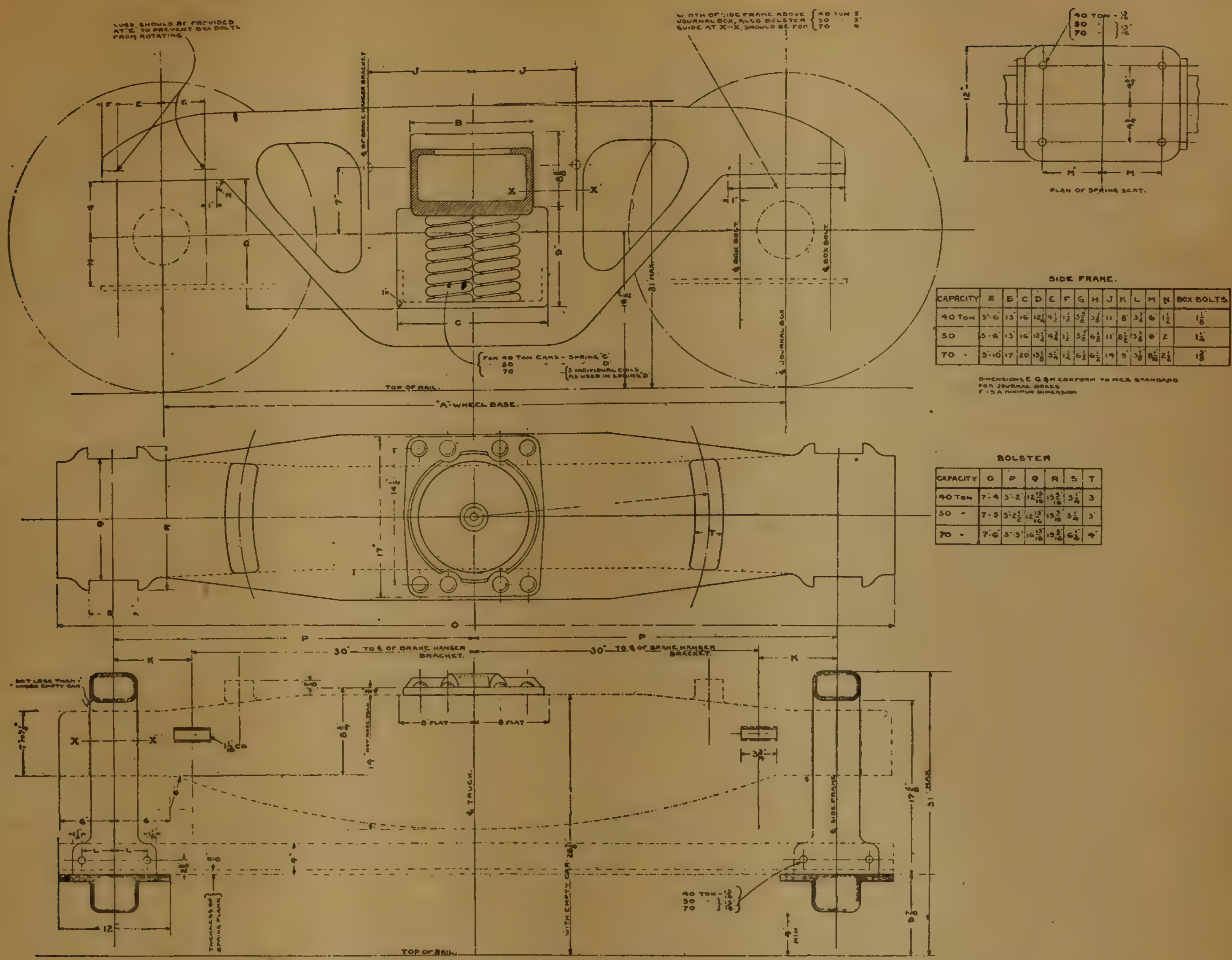


Fig. 1—Limiting Dimensions for Cast Steel Truck Sides and Bolsters for 80,000 Pound Capacity Cars.

After applying initial load, reduce load to 5,000 pounds and set deflection instrument at zero; apply the requisite proof load and measure deflection; reduce load to 5,000 pounds and measure the set.

Truck sides may be supported at each end, directly beneath the center line corresponding to center line of axle when side frame is in the truck and loaded at center of bolster opening midway between supports, or they may be supported in the center and loaded at the ends. The deflection and set shall be measured at the center line of spring seat.

Under Article IV. Weights. Section 13, Variation in Weights (new number 14), change to read as follows:

Limiting Weights.—Truck sides shall conform to the weights given in table. In case the castings have met all requirements except that of overweight, they may be accepted at the maximum allowable weight here specified:

Car Capacity, Pounds.	Weights, Pounds Minimum.	Normal.	Maximum.
80,000	*415	*425	*445
100,000	490	500	520
140,000	645	660	685

* Estimated.

Under Article VII (page 1130), Rejection. Section 16, Rejection (new number 17) change to read as follows:

Rejection.—In case the test pieces do not meet the specifications, all castings from the entire melt shall be rejected. All castings which fail to meet the requirements of the proof test shall be rejected.

Gages have been designed to cover the limiting dimensions of cast steel truck sides with tolerances which each truck side must pass.

DESIGN FOR CAST STEEL TRUCK BOLSTERS AND REVISION OF SPECIFICATIONS.

The manufacturers of cast steel bolsters were requested to submit drawings of the different truck bolsters manufactured, and the committee has tabulated therefrom the important dimensions. There is a wide variation in all of these dimensions, precluding the possibility of taking as a base any group of bolsters being manufactured at present; hence it was necessary for the committee to develop dimensions jointly for the cast steel truck sides and bolsters, keeping within general limiting dimensions for clearances and using the most adaptable sections for cast steel that would give the desired strength with minimum weight represented by the specifications.

Center Plates, Removable Type.—After careful consideration it was decided to design the bolsters for removable center plates. Making provision in the new bolsters for detachable center plates not only avoids some bad conditions but simplifies the manufacture and permits the use of a drop forged center plate, which is giving very much better service than the cast steel. The slight increase in first cost of the bolster with the removable center plate is more than offset by its advantages.

Adjustable Side Bearings.—The committee in report of last year stated that it was the intention to make provision for adjustable side bearings. Accordingly the committee designed the truck bolsters to be equipped with flat adjustable side bearings. Provision has also been made for the use of roller or other anti-friction side bearings by establishing a uniform slope, ratio of 1 inch in 28 inches, in that portion of the top plate of bolster where these side bearings will be located. Where roller side bearings are used the pockets for the adjustable side bearings are to be omitted.

The committee designed the bolsters accordingly and submits for approval designs of 80,000, 100,000 and 140,000 pounds capacity cars. Fig. 2 shows design for 80,000 pounds capacity.

Specifications and Tests.—As the committee is recommending a definite design of truck bolsters for each capacity car, based on a series of tests, it is felt that a proof load test may be omitted. The following changes in the specifications of the present recommended practice are submitted for approval:

(M. C. B. Proceedings, 1913, page 1132.)

Under Article III. Weights. Change Section 13, Weights, to read as follows:

Limiting Weights.—Bolsters shall conform to the weights given in table. In case the castings have met all requirements except that of overweight, they may be accepted at the maximum allowable weight here specified.

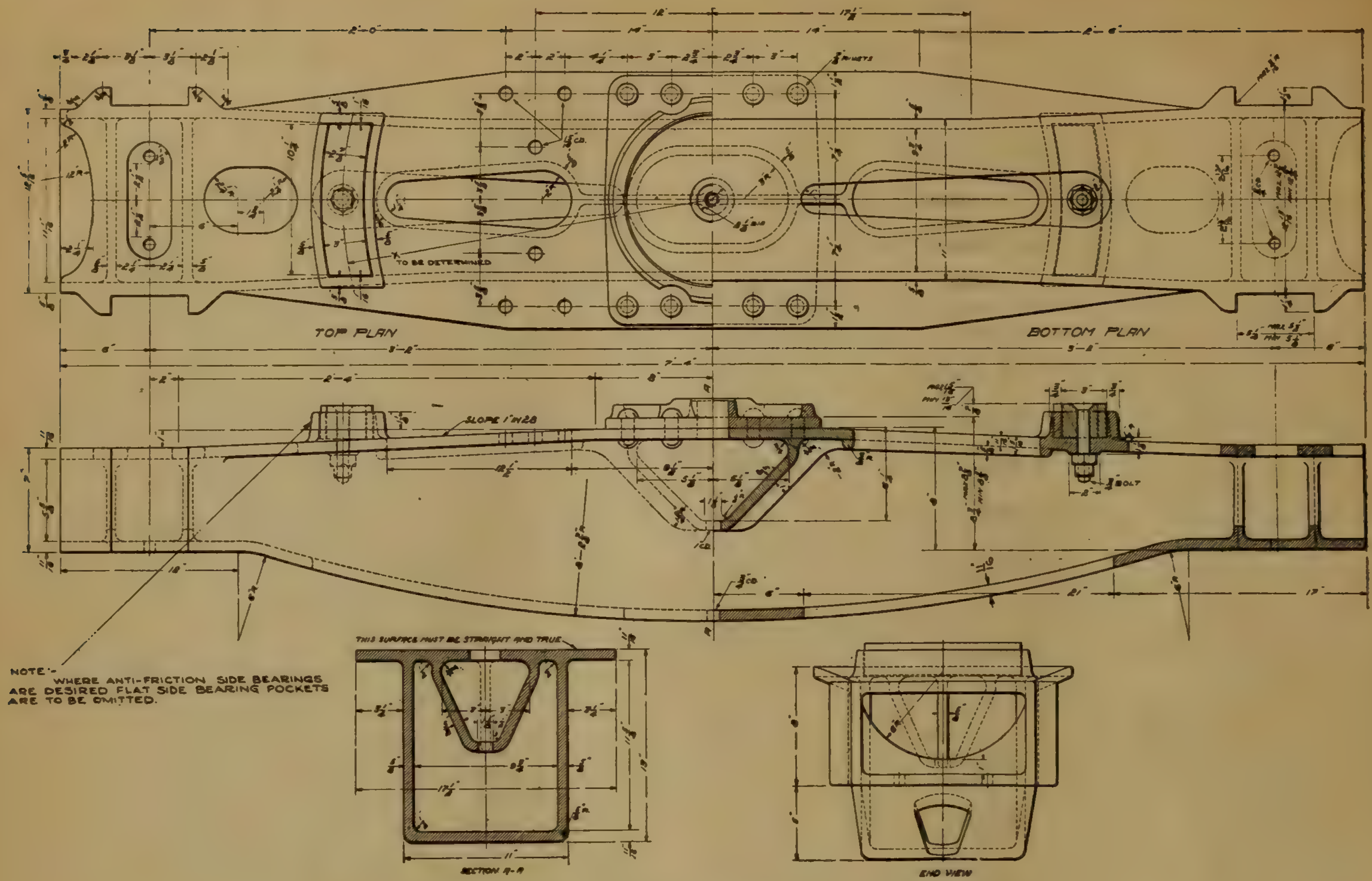


Fig. 2—Cast Steel Truck Bolster, 80,000 Lbs. Capacity Car.

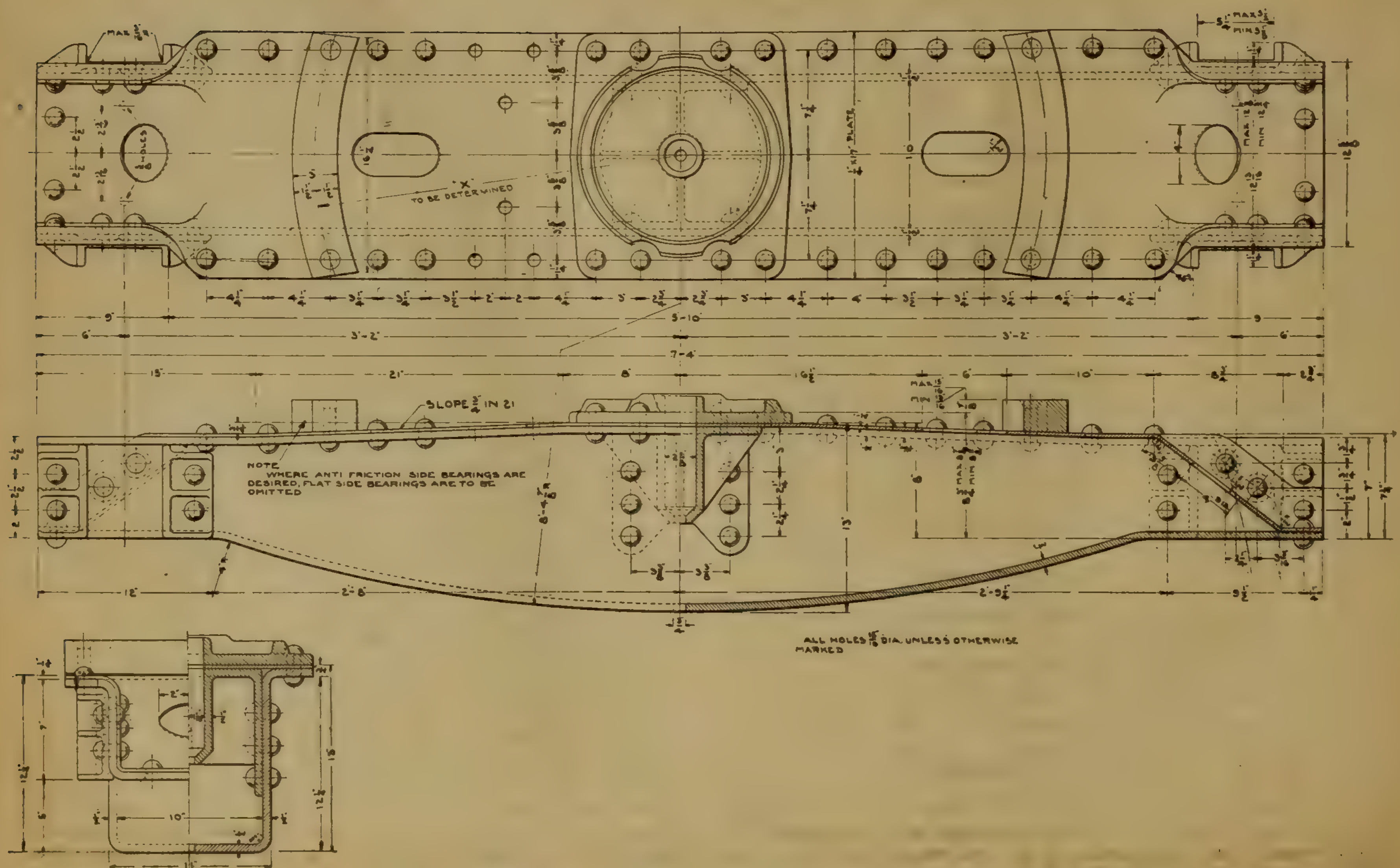


Fig. 3—Pressed Steel Truck Bolster, 80,000 Lb. Capacity Car.

Car Capacity, Pounds.	Weights, Pounds Minimum.	Normal.	Maximum.
80,000	*660	*675	*700
100,000	735	750	780
140,000	*855	*875	*910

* Estimated.

Pressed Steel Bolsters, Alternate Standard.—As the pressed steel bolsters (built-up type) are in general use, the committee deemed it advisable to also present designs for consideration which are interchangeable with the cast steel bolsters and which would provide an alternate standard. Fig. 3 shows the design for 80,000 pounds capacity cars.

Gages.—Gages have been designed with tolerance for gaging the bolster as well as to provide for interchangeability.

SPREAD OF SIDE BEARINGS.

On account of the great difference in opinion among the various roads, the committee has not been able to decide on the proper distance for spread of side bearings on 100,000-pound cars and those of less capacity. In view of the fact that there are comparatively few 140,000 pounds capacity cars in the country, the committee has seen its way clear to recommend a spread of 50 inches, center to center, on cars of this capacity, and believes that it would be wise to make the same recommendation in regard to other capacity cars, but desires to have another year to go over the matter thoroughly before making a definite recommendation for the 80,000 and 100,000 pounds capacity cars.

CLEARANCE OF SIDE BEARINGS.

The clearance of side bearings depends on the spacing or spread of the side bearings. The committee recommends the following:

Side Bearing Clearance for New Cars.

	Minimum.	Maximum.
Per side bearing	1/8 inch	3/16 inch
Total (one truck)	1/4 inch	3/8 inch

CONSTRUCTION OF CENTER PLATES FOR STANDARD FREIGHT CARS.

This subject was touched upon in last year's report. The members were requested to communicate to the committee any data showing wherein the present standard center plate has proven unsatisfactory, as well as any recommendation they may have to make. The committee has received no requests for changes, and from their knowledge the performance of the M. C. B. standard center plate under cars of 80,000, 100,000 and 140,000 pounds capacity has been satisfactory. A change in the over-all height of the center plates as well as the rivet spacing is necessary to make these center plates applicable to cars of steel construction and to the bolsters recommended. It is essential that the center plates be made of either steel castings or drop forgings; the latter are preferable, as they can be more accurately manufactured and have smoother bearing surfaces, the cost being slightly in favor of the drop forging.

SPRINGS FOR TRUCKS.

The cast steel truck side limiting dimensions and the bolsters for the 80,000, 100,000 and 140,000 capacity freight cars have been designed to accommodate the springs shown on Sheet M. C. B. "H" of Recommended Practice, as follows:

Spring "C" for cars 80,000 pounds capacity.

Spring "D" for cars of 100,000 pounds capacity.

Five double-coil cluster—made up of coils the same as used in Spring "D"—for cars of 140,000 pounds capacity.

This enables the same design outside and inside coils to be used for all three capacity trucks by varying the combination of number of coils and using the different design of spring caps according to capacity.

Experiments with alloy steel springs are still in progress but not developed to the stage where definite recommendations can be made.

STRENGTH OF ARCH BAR TRUCKS AS COMPARED WITH CAST STEEL TRUCK SIDES.

Tests were conducted on cast steel truck sides, and the results of two of these, which are representative of the modified M. C. B. specifications, as well as the results with the arch bar types, were plotted graphically to show comparative center line deflection and permanent set.

These comparative tests show conclusively the decided superiority of cast steel truck sides, conforming to the modified M. C. B. specifications, over the arch bar truck sides.

GAGES FOR 6 INCH BY 11 INCH JOURNAL BOXES.

Gages for 6 inch by 11 inch journal boxes were adopted as recommended practice last year. Instructions governing the use of the gages were presented in the report.

SAFETY HANGERS FOR BRAKE BEAM.

The committee on standard and recommended practice referred to the committee on freight car truck the following from A. R. Ayers, general mechanical engineer, New York Central Lines: "The matter of falling brake beams on freight cars is a serious one, and we believe is of enough importance to be called to the attention of the M. C. B. Association, with the idea of bringing about some action that will provide for the application of some device for preventing brake beams falling on track due to failure of hangers, preferably by the application of safety straps to the truck spring plank. We would suggest that this matter be called to the attention of the committee on standards and recommended practice, in order to get something started along this line."

The committee has given this subject careful thought and their experience with the majority of brake beam safety hangers has been that these devices have been inefficient and a source of expense from a maintenance standpoint. Unless they are designed with a strength at least equal to the loads imposed upon the brake beam hangers and to prevent wear, they will not be efficient when the emergency arises for them to perform their function. Furthermore, with the present lack of interchangeability and the uniformity of design of brake beams and trucks, it would be impracticable to design a standard safety hanger which would be generally applicable. The committee finds little cause for the employment of brake beam safety hangers where the brake beam hangers and connections are designed and manufactured with proper care, and believe that the remedy lies along these lines rather than in the adoption of the auxiliary device of brake beam safety hangers.

Committee: J. T. WALLIS (chairman), J. J. TATUM, E. W. PRATT, JAMES COLEMAN, PROF. M. C. SCHMIDT, L. C. ORD, J. MCMULLEN.

Discussion.

C. E. Fuller: I believe that the radial clearance on center plates should be changed from 1/8 to 1/4 inch.

C. E. Chambers: I do not think that the report shows enough clearance on the side bearings. We have had cars derailed with 1/4-inch clearance, but found that by making it 3/8 inch we stopped derailments.

L. C. Ord: The committee has taken care of side bearing adjustment so far as it could. We would like more information from the roads with regard to this subject.

J. J. Hennessey: I move that the report be referred to letter ballot. This motion was carried.

R. L. Kleine: The committee on specifications and tests are now making experiments with alloy steel springs, and I move that this portion of the above report be referred to the committee above mentioned.

This motion was carried.

FRIDAY, JUNE 12.

DAMAGE TO FREIGHT CAR EQUIPMENT BY UNLOADING MACHINES.

Much has been accomplished in reducing the damage to freight cars by those applying the blocking to their movable platen type machines in accordance with typical design submitted to the 1913 convention, and adopted as recommended practice.

A member of the committee called on the manufacturers of the machines of the solid floor type and suggested that they give some consideration to modifying their hydraulic clamping arrangement to eliminate the damage to cars. It was found that after receipt of the 1913 report they had done some preliminary work along the line suggested and would be prepared to submit drawings and estimates of changes in existing machines of the solid floor type, and, further, that no more machines of that type would be built and that future machines would be of the movable platen type.

It was also found that the steel manufacturers and industrial plants are taking a keen interest in the matter and had a committee of thoroughly competent members going over the individual machines, and were having blocking applied as per our recommended practice to movable platen type machines and corrections made to those of the solid floor type.

There are a number of new car-dumping machines being installed this year with cradles of increased length to accommodate the larger cars, and after this year's experience with them is analyzed some modification in recommended practice may be necessary for these machines.

For existing machines we have no modifications of our report of 1913 to recommend, but would impress on all the need of properly spotting cars in cradle, the importance of maintaining blocking by renewing face, the absolute necessity of maintaining extension clamps at all times, and to properly supervise machines at industrial plants to insure their carrying out the recommendations of this association.

Committee: P. F. SMITH, JR. (chairman), J. J. TATUM, I. S. DOWNING, J. J. BIRCH, P. J. O'DEA, J. H. MILTON.

The report was received and the committee continued.

SPECIFICATIONS AND TESTS FOR MATERIALS.

The committee was instructed to revise certain specifications of the association and prepare new ones covering certain other classes of material covered in the recommendations of last year's committee on form.

Specifications covering sixteen (16) different classes of material were sent out for criticism by the members, and as a result of these criticisms and subsequent meetings it was agreed that the following named materials only could be handled this year: Air-brake hose, heat-treated knuckle pivot pins, steel axles, refined wrought-iron bars, welded pipe, helical springs, chains, journal-box brasses; and that the specifications covering the following materials could be further investigated and specifications offered at the next annual meeting: Refrigerator car heat-insulation materials, mild-steel bars for miscellaneous parts, steel castings, rivet steel and rivets, structural steel and steel plates, galvanized sheets, malleable-iron castings, elliptic springs.

The committee has been in correspondence with the Association of Rubber Goods Manufacturers during this year and are co-operating with them in order to establish standard methods of making tests and standard test apparatus, as there are no standards covering the testing work for this class of material in existence today.

The specifications covering air brake and signal hose for passenger and freight equipment cars have been revised, changing the form of the specifications and explaining the methods of test, but the committee has endeavored not to make any changes in the requirements of the specifications other than those in existence as standard, and as adopted in 1913.

The committee recommends that the revision of the specifications for air brake and signal hose for passenger and freight equipment cars be made standard.

That the specifications offered for steel axles be adopted as standard, and

That the following specifications be submitted to letter ballot as recommended practice:

Refined wrought-iron bars, heat-treated knuckle pivot pins, welded pipe, helical springs, chain, journal-box brasses.

Committee: C. D. Young (chairman), J. R. Onderdonk, J. J. Birch, J. S. Downing, E. P. Tilt, Frank Zeleny, J. S. Sheafe, J. W. Taylor.

The important specifications for recommended practice follow:

SPECIFICATIONS FOR WELDED PIPE FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

(a) Steel used in the manufacture of pipe shall be of a soft, weldable quality made by the Bessemer process.

(b) The wrought iron used in the manufacture of pipe shall be double-refined.

(c) All pipe 2 in. nominal diameter or under may be butt-welded, but all pipe larger shall be lap-welded.

PHYSICAL PROPERTIES AND TESTS.

The material shall conform to the following minimum requirements as to tensile properties:

	Steel.	W. I.
Tensile strength, lb. per sq. in.	50,000	45,000
Elastic limit, lb. per sq. in.	30,000	.....
Elongation in 8 in., per cent	18	12

A section of pipe 6 in. long shall be placed in a compression machine with the weld at the top and flattened until the distance between the plates of the machine is 60 per cent of original external diameter for wrought iron and 25 per cent for steel pipe. The pipe shall not show any opening, except that opening of the weld will not be considered cause for rejection.

A sufficient length of pipe to be bent cold 180 deg. around a mandrel the diameter of which is 18 times the nominal diameter of the pipe without any opening of weld or cracks in any portion of pipe.

WEIGHTS.

The standard weights for pipes of various inside diameters are as follows:

Standard Grade Pipe — Single Thickness.			Extra Strong Pipe — Double Thickness.		
Nominal Diameter, Inches.	Outside Diameter, Inches.	Weight of Pipe per Lin. Ft. threaded with Couplings.	Outside Diameter, Inches.	Weight of Pipe per Lin. Ft. Plain Ends.	No. of Threads.
1/8	.405	.25	.405	.31	27
1/4	.540	.43	.540	.54	18
3/8	.675	.57	.675	.74	18
1/2	.840	.85	.840	1.09	14
3/4	1.050	1.13	1.050	1.47	14
1	1.315	1.68	1.315	2.17	11 1/2
1 1/4	1.660	2.28	1.660	3.00	11 1/2
1 1/2	1.900	2.73	1.900	3.63	11 1/2
2	2.375	3.68	2.375	5.02	11 1/2
2 1/2	2.875	5.82	2.875	7.66	8
3	3.500	7.62	3.500	10.25	8
3 1/2	4.000	9.20	4.000	12.51	8
4	4.500	10.89	4.500	14.98	8

Ten per cent of each lot shall be weighed and a comparison made with the sample. All pipe shall be rejected that varies more than 5 per cent from that given in the above table.

SPECIFICATIONS FOR HEAT-TREATED KNUCKLE PIVOT PINS FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

The steel shall be made by the open-hearth process.

The pins shall be properly heat-treated to meet the requirements of the physical tests.

CHEMICAL PROPERTIES AND TESTS.

The steel shall conform to the following requirements as to chemical composition:

Carbon	0.55 — 0.70 per cent
Manganese	0.40 — 0.60 per cent
Phosphorus, not over	0.05 per cent
Sulphur, not over	0.05 per cent
Silicon	0.15 — 0.25 per cent

An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. Drillings for analysis shall be taken not less than 1/4 in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative.

PHYSICAL PROPERTIES AND TESTS.

This test shall be made on a standard "M. C. B." drop-test machine, the pins resting on rounded supports held rigidly 10 in. center to center, to be subjected to a blow by a standard weight of 1640 lb. falling from a height of 3 ft., and shall show a deflection not less than 15 deg. or more than 35 deg. without cracking or breaking.

The manufacturers shall furnish, free of charge, one extra pin with each lot of 200 or less.

PERMISSIBLE VARIATIONS.

The diameter of the pins shall conform to the standard M. C. B. limit gages for rounds. The length shall not vary more than 1/8 in. below or above that specified.

SPECIFICATIONS FOR STEEL AXLES FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

The steel shall be made by the open-hearth process.

CHEMICAL PROPERTIES AND TESTS.

The steel shall conform to the following requirements as to chemical composition:

Carbon	0.38 — 0.52 per cent
Manganese	0.40 — 0.60 per cent
Phosphorus, not over	0.05 per cent
Sulphur, not over	0.05 per cent

An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. Drillings for analysis shall be taken not less than 1/4 in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative. This analysis shall conform to the requirements specified in Section 2.

PHYSICAL PROPERTIES AND TESTS.

The axles shall conform to the following drop-test requirements:

(a) The test axle shall be so placed on the supports that the tup will strike it midway between the ends. It shall be turned over after the first and third blows, and when required after the fifth blow. When tested in accordance with the following conditions, the axle shall stand the specified number of blows without fracture, and the deflection after the first blow shall not exceed that specified in Table No. 1.

Size of Axle, In.				Weight of Tup, Lb. 1 640			2 200		
Journal.	Diameter at Center.	Capacity of Cars, Lb.	Distance between Supports, Ft.	Height of Drop, Ft.	Number of Blows.	Max. Deflection, In.	Height of Drop, Ft.	Number of Blows.	Max. Deflection, In.
4 1/4 x 8	4 3/4	60,000	3	34	5	7 1/2	..	..	...
5 x 9	5 5/8	80,000	3	43	5	6 1/4	..	..	...
5 1/2 x 10	5 7/8	100,000	3	43	7	4 1/2	..	..	...
6 x 11	6 7/8	....	3	..	..	...	40	7	5 1/4

(b) The deflection is the difference between the distance from a straight edge to the middle of the axle, measured before the first blow, and the distance measured in the same manner after the blow. The straight edge shall rest on the collars or the ends of the axle.

The anvil of the drop-test machine shall be supported on 12 springs, as shown on the M. C. B. drawings, and shall be free to move in a vertical direction, and shall weigh 17,500 lb. The radii of the striking face of the tup and of the supports shall be 5 in.

(a) One drop test shall be made from each melt. Unless otherwise specified, not less than 30 axles shall be offered from any one melt.

(b) If the test axle passes the physical tests, the inspector shall draw a straight line 10 in. long parallel with the axis of the axle, and starting with one end of it he shall prick-punch this line at several points. A piece 6 in. long shall be cut from this same axle so as to leave some prick-punch marks on each piece of axle. Drillings for chemical analysis shall be taken by using a 5/8-in. drill and drilling in the cut-off end 50 per cent of the distance from the center to the circumference and parallel with the axis of the axle.

SPECIFICATIONS FOR REFINED WROUGHT-IRON BARS FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

The finished product shall consist either of new muck-bar iron or a mixture of muck-bar iron and scrap, but shall be free from any

admixture of steel. Muck bars shall be made wholly from puddled iron.

PHYSICAL PROPERTIES AND TESTS.

Unless otherwise specified, the iron shall conform to the following requirements as to tensile properties:

Tensile strength, lb. per sq. in.........47,000—53,000
Elongation in 8 in., minimum per cent...............22

Large sections reduced or flats and rounds of ½ in. or under may show a tensile strength of 45,000-52,000 lb. per sq. in.

Twenty per cent of the test specimens representing one size may show the following percentage of elongation in 8 in.:

½ in. or over, tested as rolled..............20 per cent
Under ½ in., tested as rolled..............16 per cent
Reduced by machining.....................18 per cent

FLAT BARS:

⅝ in. or over, tested as rolled.............18 per cent
Under ⅝ in., tested as rolled..............16 per cent
Reduced by machining......................16 per cent

Cold-bend Test.—For round, square and hexagon bars under 2 sq. in. in section, and for flats less than ¾ in. thick, shall bend cold thickness of the specimen. For rounds, flats and hexagon bars 2 sq. in. or over in section, and for all flat bars over ¾ in. in thickness, around a pin the diameter of which is equal to twice the diameter or thickness of the specimen.

Hot-bend Test.—The test specimen, when heated to a temperature between 1,700 and 1,800 deg. F. (light cherry red), shall bend through 180 deg. without fracture on the outside of the bent portion, as follows: For round, flat and hexagon bars under 2 sq. in. in section, flat on itself; for round, flat and hexagon bars 2 sq. in. and over in section, around a pin the diameter of which is equal to the diameter or thickness of the specimen.

Nick-bend Test.—The test specimen, when nicked 25 per cent around the round bar, and along one side for flat bars, with a tool having a 60-deg. cutting edge, to a depth of not less than 8 or more than 16 per cent of the diameter or thickness of the specimen, and broken, shall not show more than 10 per cent of the fractured surface to be crystalline.

PERMISSIBLE VARIATIONS IN GAGE.

Round Bars.—Shall conform to the standard M. C. B. limit gages.

Flat Bars.—Thickness shall not vary more than corresponding diameter for rounds: thus, 1 in. thick could vary from 0.9905 to 1.0095 in.

(1) Sizes under 3 in. wide shall not be more than 1/32 in. under or over size in width.

(2) Sizes 3 in. and over shall not be under size or more than $\frac{1}{16}$ in. wider than ordered.

SPECIFICATIONS
FOR
HELICAL SPRINGS FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

The steel shall be made by the open-hearth, electric or crucible process.

CHEMICAL PROPERTIES AND TESTS.

The steel shall conform to the following requirements as to chemical composition:

	Bars 1 in. and under.	Over 1 in.
Carbon	0.90—1.10 per cent	0.95—1.15 per cent
Manganese, not over.....	0.50 per cent	0.50 per cent
Phosphorus, not over.....	0.05 per cent	0.05 per cent
Sulphur, not over.......	0.05 per cent	0.05 per cent

An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, to determine the percentage of carbon, manganese, phosphorus, sulphur and silicon. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the test ingot. A copy of this analysis shall be given the purchaser or his representative. This analysis shall conform to the requirements specified in Section 2.

PHYSICAL PROPERTIES AND TESTS.

Free Height.—Place each spring on a flat plate and measure the distance between the plate and the other end of the spring. This measurement is the free height.

Solid Height.—Place the measured springs, either singly or in lots, in the testing machine and apply a load at least 25 per cent greater than the capacity of the springs, then measure the distance between the two plates of the machine. This is the solid height.

Set.—Remove the load and again measure the free height at the same point in the circumference at which the first free height was taken. If now the second free height is less than the first by more than 1/32 in., the spring or springs will be regarded as having taken permanent set and will be excluded from further consideration.

Working Height.—Apply the specified working load and measure the height.

PERMISSIBLE VARIATIONS AND WEIGHTS.

All springs shall not vary more than ⅛ in. from specified height or $\frac{1}{16}$ in. from specified diameter.

Ten per cent of the springs shall be weighed, and if any springs are found that weigh less than the specified minimum, the whole lot shall be weighed and all springs that weigh less than the minimum shall be excluded.

SPECIFICATIONS
FOR
CHAIN FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

MANUFACTURE.

The chain may be made of either iron or soft steel. Chain $\frac{5}{16}$ in. in diameter or less may have links twisted, if so specified on the order; all other sizes shall have straight links.

A piece of chain 2 ft. long will be taken from every 200 ft. or less of each size presented for shipment and tested to destruction in accordance with Table No. 1.

The length of 100 links, inside to inside of end links, shall not exceed by more than 2 per cent the figures given in Table No. 1.

The average weight per ft. shall not exceed that given in Table No. 1 and shall not vary more than 8 per cent below.

SPECIFICATIONS
FOR
JOURNAL-BOX BRASSES FOR PASSENGER AND FREIGHT EQUIPMENT CARS.

CHEMICAL PROPERTIES AND TESTS.

The shell shall conform to the following requirements as to chemical composition:

Lead ....10.00—30.00 per cent
Tin, not over.....................7.00 per cent
Copper to be remaining.......... ... per cent

The lining metal shall conform to the following requirements as to chemical composition:

Lead or tin........................Optional per cent
Antimony, not over................. 14.00 per cent

PHYSICAL PROPERTIES AND TESTS.

A finished bearing shall be broken through the middle to ascertain the uniformity of the grain of the metal. Where metal shows distinct signs of imperfect mixing, such as separation of component parts, dross or dirt spots, the lot shall be rejected.

PERMISSIBLE VARIATIONS IN GAGINGS.

All bearings shall conform to gages and dimension shown on drawings, and when linings are required they shall conform to the gages and dimensions for linings as shown on drawings.

The report was approved and submitted to letter ballot. The committee was continued.

CAR CONSTRUCTION.

CENTER SILLS FOR NEW CARS.

The committee carefully reviewed the steel-car situation in order to formulate recommendations as a guide for new work.

Designs of cars which do not go into general service in interchange may be considered only from their own load-carrying standpoint, without regard to train strains; but those used in interchange must be considered from both standpoints. For the latter, the committee recommends the following as minimum design requirements to produce cars giving maximum returns for money expended:

Area of center sills: 24 sq. in. minimum.

Ratio of stress to end load: 0.06, maximum.

Length of center or draft sill members between braces: 20 d, maximum ("d" is the depth of the member, measured in the direction in which buckling might take place).

BOX-CAR END, DESIGN AND STRENGTH.

When existing box-car ends need renewal they should be reinforced between corner posts with the equivalent of two steel braces, each having a section modulus of 4, or more. These braces may be applied vertically, horizontally or diagonally.

New cars should have steel plate ends ¼ in. thick, reinforced between corner posts with the equivalent of either two vertical steel braces with a total section modulus of not less than 9; or one vertical and two diagonal steel braces with a total section modulus of not less than 10; or three horizontal steel braces with a total section modulus not less than 10.

New cars may have the following alternative arrangement: Three or more steel braces, two of which run diagonally, with a total section modulus of not less than 12½, and wood lining 1¾ in. thick.

To concentrate strength at a point near floor line on vertical center line of car, diagonal braces should extend from the center sills to the side plates, and not from the bottom corner to the ridge.

The attachments for the braces and the members to which they are attached must be sufficiently strong to realize the full strength of the braces. Hardwood or yellow pine may be considered equivalent to the steel members, if the section modulus is four times as great. Wooden posts and braces should be set in metal pockets not less than 1½ in. deep, and must be held in place by adequate tie rods. Lining at car ends should be supported at intervals not greater than 30 times the thickness. Two 4 by 3 in. Z bars, 12.4 per ft., have a total section modulus of 9.34. Two 5-in. I beams, 9.75 lb. per ft., have a total section modulus of 9.6. Three 4-in. I beams, 9.5 lb. per ft., have a

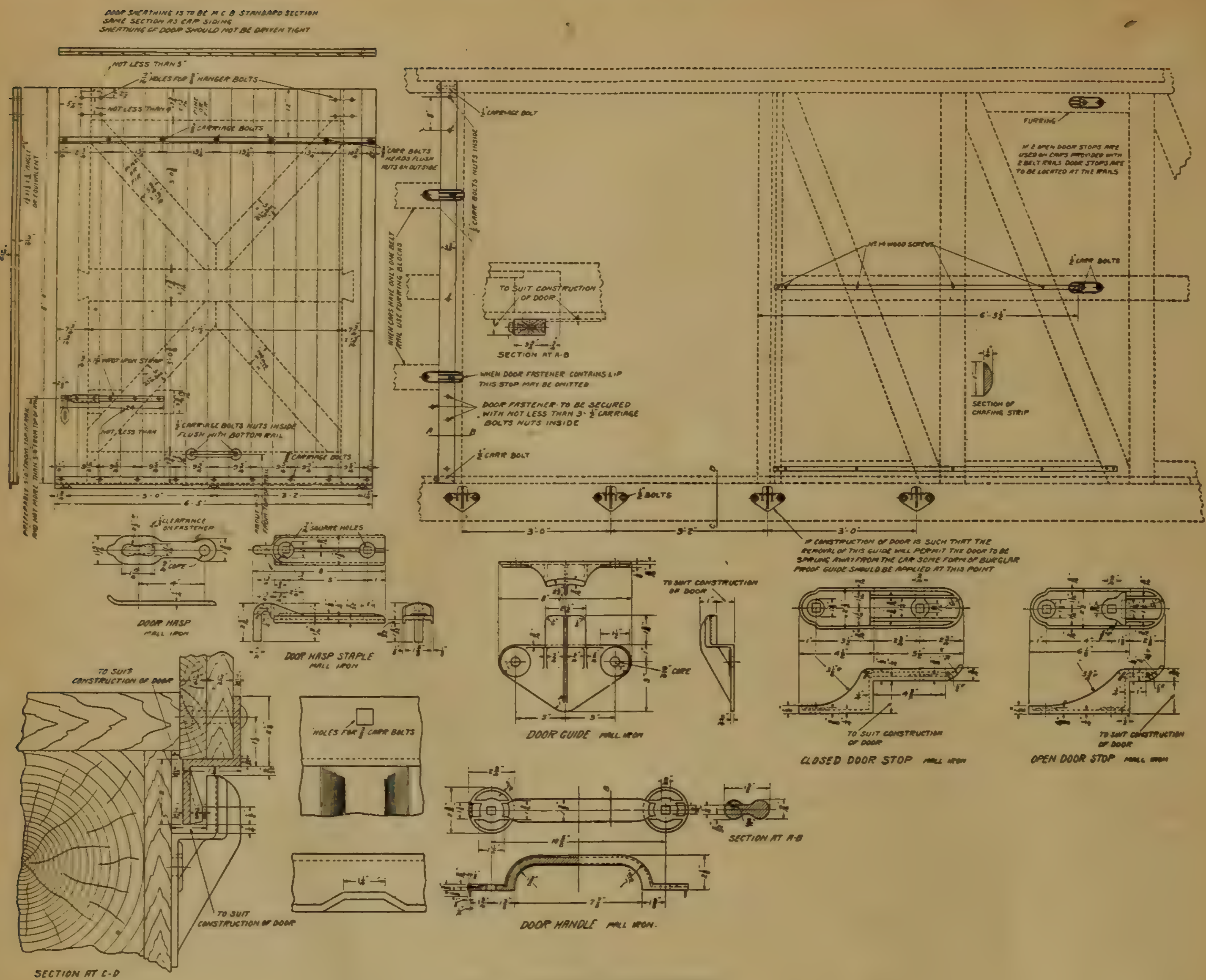


Fig. 1—Box Car Construction.

total section modulus of 10.2. Three 3-in. Z bars, 14.2 lb. per ft., have a total section modulus of 10.3. Types of end similar to Van Dorn ends, made of ¼-in. plate, or Murphy ends, with the lower half made of ¼-in. corrugated plate, and the upper half with $\frac{3}{16}$-in. corrugated plate, may be substituted for those described.

CAR DOORS AND FASTENINGS.

One of the most important parts of the car-door propositions, at present, is to reinforce the doors and door fastenings on some existing box cars in the least expensive manner that will make them safe and serviceable. In many cases this does not require new doors, but only additional fittings or reinforcements. For this reason it is thought advisable to make one recommendation to cover the betterment of existing construction, and another to cover all new construction. On account of the patent situation, the committee does not feel that it is feasible to present full detailed designs of doors and fastenings without eliminating some of the best-known construction, and, therefore, prefers to present its recommendations in specification form, as follows:

Specification for reinforcing existing doors:

The necessary additional number of bottom door guides should be provided to make four on each side of the car—one adjacent to each door post, one in the middle of the doorway, and the other between the back door post and the open door stop, located approximately as shown in Fig. 1, and similar in design, with particular reference to the height of lip, which should be 1¾ in. If the design of the door is such that the removal of the door guide next to the door post would permit the door to be pulled away from the car, then this door guide should be of such design that it can not be removed when the door is closed.

Doors should be reinforced against bulging by the equivalent of two 1½ by 1½ by $\frac{3}{16}$ in. angles extending horizontally the full width of the door, one located approximately 12 in. from the top of the door, and the other approximately 12 in. from the bottom of the door, and fastened with ⅜-in. carriage bolts.

The door-hasp fastener should be at least 24 in. long, fastened with not less than five ⅜-in. bolts with the nuts on the inside of the door. The door-hasp fastener should be of such design that the hasp can not be removed without removing the bolts from the fastener.

The closed door stop should have two or more lips extending at least 1½ in. over the door to support the door against bulging outward. Where all-wood closed door stops are used, they should be strengthened against splitting, and should have at least two metal reinforcing brackets similar to closed door stop casting shown on Revised Sheet M. C. B. 30.

Open door stops, if of wood, should extend the full height of the door and be strengthened against splitting.

SPECIFICATIONS FOR COMPLETE NEW DOORS FOR EXISTING CARS OR FOR NEW CONSTRUCTION.

The upper door track should be continuous, and strong enough so that it will not sag, securely fastened to the car with ½-in. bolts, or ⅜-in. rivets not less than six in number, and so designed that it will continuously support the door against outward pressure independent of any action of the door hangers, and will also keep out rain and snow, proper flashing, if necessary, to be provided over the door track. The design of track and hangers should be such that when the door is being opened or closed it can not lift up and bind against the track.

Bottom door guides to have 1¾-in. lip, and to be four in number—one located adjacent to each door post, one in the middle of the doorway, and one between the back door post and the open door stop, located approximately as shown in Fig. 1, and similar in design, with particular reference to the height of lip, which should be 1¾ in. If the design of the door is such that the removal of the door guide next to the open door post would permit the door to be pulled away from the car, then this door guide should be of such design that it can not be removed when the door is closed.

Metal open doors are recommended, one or more in number, of design shown in Fig. 1, securely bolted to the framing of the car with

½-in. bolts. If wood open door stop is used, it should extend the entire height of the door and be strengthened against splitting.

The back edge of the door and the back door post should be so constructed that when the door is closed and fastened it will be continuously supported from top to bottom against outward pressure, and will also be protected against leakage of rain or snow and admission of sparks.

Closed door stop to be preferably of metal, and to provide protection against leakage or rain or snow and admission of sparks. The closed door stop must also support the door against outward pressure, either continuously from top to bottom, or by the use of two or more lips projecting at least 1½ in. over the door, approximately as shown on Revised Sheet M. C. B. 30. If wooden closed door stops are used, they must be strengthened against splitting and must be provided with at least two metal closed door stops provided with lips to project over the door at least 1½ in. to support the door against bulging outward, as shown on Revised Sheet M. C. B. 30.

Wood doors should have preferably a metal frame, with a Z bar or its equivalent at the bottom, approximately as shown on Revised Sheet M. C. B. 30. the Z bar acting as a stiffener and also engaging with the bottom door guides. This construction or its equivalent permits the use of door guides which project a very short distance from the side of the car, and are, therefore, less subject to injury, particularly the door guide at the middle of the doorway.

Wooden frame doors, if used, should be at least as strong as that shown in Fig. 1.

The door-hasp fastener should be at least 24 in. long, fastened with not less than five ⅝-in. bolts, with nuts on the inside of the door. The door-hasp fastener should be of such design that the hasp can not be removed without removing the bolts from the fastener.

Door-hanger bolts to be located not closer together than 4 in. one way, and 5 in. the other. Four ⅝-in. bolts are recommended.

It is understood that all of the above recommendations apply particularly to 6-ft. door openings of cars with single, outside-hung side doors, and in all cases where a particular construction is described or specific dimensions are given, their equivalents will be acceptable.

PLACARD BOARDS FOR BOX CARS.

The committee recommends that the space available for placards should be not less than 16 in. by 24 in. on each end and each side of car.

Box cars with sufficient space available on wood siding, or exposed lining, should have a rectangular space, painted black, on each side and each end. Other box cars should be provided with placard boards, made of soft wood, not less than 16 by 24 by 1 in. The vertical edge should be reinforced with metal protection, and the bolts fastening the boards to the car should be not less than six in number, and should pass through the metal reinforcing pieces, three through each. The boards may be made of more than one piece, and should then be tongued and grooved. The distance from the floor line of car to bottom of board should be not less than 4 ft. 6 in.

Routing-card boards, preferably the same size as the placard boards described, should be placed on the side of the car, as near as possible to the door seal.

DRAFT GEAR.

The committee recommends that cars should not be accepted in interchange unless equipped with draft gears and attachments having strength or capacity equivalent to or greater than the following requirements:

The section area of draft timbers located underneath the center sills must be not less than 32 sq. in. Each draft timber must be not less than 4 in. wide, nor less than 6 in. deep, and must be held securely to the center sills and end sills by not less than seven ⅞-in. bolts, or six 1-in. bolts.

Draft timbers extending through or beyond the bolsters must be secured to the center sills by two or more additional bolts. Draft-gear yokes must be not less than 4 in. wide by 1 in. thick, made of wrought iron or steel, and attached to the coupler side with not less than two 1⅛-in. rivets. Draft springs must have a capacity of at least 19,000 lb. Should cars require repairs to bring them up to these minimum requirements, the following recommendations are offered:

Draft timbers should butt against the body bolsters and shoulder against the end sills, both of which in turn should be well secured against shifting from either pulling or buffing strains. Draft gear stops should, whenever possible, be gained into the draft timber or heeled on the end sills. Front and back draft-gear stops may be made in one piece, or may be secured to a metal plate not less than $\frac{7}{16}$ in. thick, or made separate. Each stop (counting two stops riveted to a $\frac{7}{16}$-in. plate as one piece) must be secured to the draft sill by not less than six ¾-in. bolts or their equivalent. The center sills should be strengthened by the use of a filling or packing piece secured between the same, butting against the end sill and extending beyond the body bolster toward the center of the car, a distance at least as much as between the bolster and end sill.

The present M. C. B. coupler side clearance of 2½ in. should also be provided.

Committee:—W. F. KIESEL, JR., (chairman); A. R. AYERS, S. G. THOMSON, C. E. FULLER, H. H. VAUGHAN, E. O. CHENOWITH, J. C. FRITTS, T. M. RAMSDELL, C. L. MEISTER.

Discussion.

H. H. Vaughan: I cannot subscribe to the recommendation on center sills for new cars. Until interchange requirements demand a minimum strength of center sill, it will be useless to specify the dimensions for new cars. I also think the report should be amended to read "New steel cars should have steel plate ends 1¼ in. thick, or wood lined ends 1¾ in. thick," and the statement regarding alternative arrangement should be omitted. Angles for doors should be located not over 12 in. from top and bottom and should be used with ⅝ in. carriage bolts, or ¼ in. rivets.

James Coleman: Some railroads have a number of cars with less area than required by this report.

J. J. Hennessey: This report should be a report of progress, for the roads are not prepared to make so many radical changes.

W. F. Kiesel, Jr.: I move that the recommendations of the committee on center sills for new cars be referred to letter ballot for adoption as recommended practice.

This motion was carried.

F. W. Brazier: The wooden door stops are now being put on, without being reinforced, and with a little fastening with only a ⅝ in. bolt in it. You may find some of these on our cars.

(Mr. Brazier read a letter from E. P. Ripley, president of the Santa Fe, relative to the views of the American Railway Association on the subject.)

The recommendations on box-car ends, design and strength and car doors and fastenings were referred to letter ballot. The recommendations on placard boards for box cars and draft gears were referred to letter ballot.

The matter of the design of a standard box car was referred to the new executive committee.

RETIREMENT OF 40,000 AND 50,000 LB. CAPACITY CARS.

The committee addressed to the members of the association the following inquiries:

First: Have you any restrictions in force regarding the use of cars of 40,000 and 50,000 lb. capacity?

Second: Do you accept in interchange cars of 40,000 and 50,000 lb. capacity; if so, is the lading transferred?

Third: Do you regard it practicable to prohibit the use of cars of 40,000 lb. capacity in interchange?

Fourth: Do you regard it practicable to prohibit the use of cars of 50,000 lb. capacity in interchange?

At the same time it requested the members to advise the committee as to the number of cars of the various capacities and several constructions operating on their lines.

The committee would recommend that the following proposed rule be submitted to special letter ballot, so that it may, if approved, be embodied in the Rules of Interchange effective October 1, 1914:

"After October 1, 1916, all cars of less than 60,000 lb. capacity having wooden or metal draft arms which do not extend beyond the body bolster, will not be accepted in interchange."

Committee:—D. F. CRAWFORD, (chairman); C. E. FULLER, J. J. HENNESSEY, F. H. CLARK, C. F. GILES, F. W. BRAZIER and R. E. SMITH.

The committee found it very difficult to make a more definite recommendation than that given.

F. F. Gaines moved that the report be accepted and be referred to letter ballot.

This motion was carried.

ELECTION OF OFFICERS.

The following officers were elected: President, D. F. Crawford; first vice-president, D. R. MacBain; second vice-president, R. W. Burnett; third vice-president, C. E. Chambers; treasurer, John S. Lentz; executive committee, R. F. Smith, J. C. Fritts, and H. T. Bentley.

The badge of office was presented to retiring President Barnum by F. W. Brazier.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.

Up to and previous to the year 1898 it was found that there was such a variation in the interpretation of the M. C. B. rules of interchange at the large interchange points of the country that it was almost impossible for one large interchange point to receive cars and have them pass through to another large interchange point without having them refused.

Henry Boutet, chief interchange inspector at Cincinnati, conceived the idea that it would be a good plan to get the different chief interchange inspectors of the country together and see if they could not come to a uniform understanding of the M. C. B. rules so that if a car passed one interchange point, and arrived at the next interchange point in the same general condition, there would be no question about it passing.

On taking the matter up with the committee on interchange inspection at Cincinnati they readily consented to the calling of

a meeting of the different chief interchange inspectors which was held at Cincinnati in April, 1898.

There were ten chief interchange inspectors present. Realizing the importance and the good that had been accomplished at that meeting, they agreed to meet again at St. Louis in September to go over the new rules effective September 1st. At this meeting there were twelve inspectors present and a large number of car foremen.

Again feeling the necessity of a general understanding or uniform interpretation of the M. C. B. rules, they thought it advisable to hold a meeting in March of the following year for the purpose of making suggestions as to changes in the M. C. B. rules that would be advantageous to the movement of cars through the interchange points throughout the country. This meeting, while making several recommendations to the arbitrating committee, adjourned to meet at Cleveland, O., in September for the purpose of arriving at a uniform interpretation of the new rules for the year.

At this meeting it was decided that so much good had been derived from the meetings that a motion was made to effect a permanent organization, at which time Mr. McKenzie, then superintendent of motive power of the N. Y. C. & St. L., stated that he did not believe in this organization before he came to the meeting but as he had listened to the discussions there had been so much brought out and discussed and uniform interpretation arrived at that he was heartily in favor of making it a permanent organization.

The motion prevailed and a permanent organization was formed, Charles Waughop, chief interchange inspector at St. Louis, being elected president and John McCabe, chief interchange inspector at Cleveland, O., being elected secretary.

The organization continued in this form until the meeting held at St. Louis in September, 1904. Car foremen became so interested in the interpretation of the rules that the constitution was changed, admitting car foremen as active members of the association.

These meetings have been held each year in September, until the meeting held at Washington, D. C., in 1910, when it was deemed advisable to change the meeting time to the latter part of August so that meetings could be held before the rules went into effect.

The meetings have been held regularly at different large interchange points ever since the organization was formed, and the interpretation of the M. C. B. rules arrived at at these meetings have been correct and have been of the greatest help in the interchange of cars throughout the country.

The meeting is to be held this year at the Hotel Sinton, Cincinnati, O., August 25th, 26th, and 27th, and the prospects are that it will be one of the largest and most important meetings in the history of the association.

It is being recognized by those in charge of car departments that the interpretation given the M. C. B. rules of interchange at the meetings of this association are of great help to all those concerned in the interchange of cars.

PACKING HOT SUPERHEATERS.

By A. E. M.

It has been the privilege of the writer within the last year or two to observe and study conditions on a great many superheater locomotives. In most cases these locomotives were observed in actual operation, and it is for the benefit of those less fortunate that a few of the lessons learned during these observations are to be set forth.

The writer, to begin with, is of the opinion, and this is backed up by many practical railroad mechanical officials, that superheater locomotives do their best work when the engine crew know that they are actually getting superheat. While, of course, an experienced engine man will know by observation that he is getting some superheat, he does not know whether he is getting full efficiency or not, and the time is not far distant when every superheater locomotive will be equipped with a reliable pyrometer that will indicate to the engine man just what they are doing in the superheated steam line at all times. Eventually, the pyrometer will be found as necessary as the steam gauge is at present.

The writer has occasion to know that there is quite a difference in superheat obtained on different locomotives, even of the same class. This knowledge was obtained by the extended use of the pyrometer and some loss of sleep. This difference in the amount of superheat obtained brings us to the matter of a proper metallic packing, or rather, to be more explicit, a proper metal for metallic packing for superheater. Not much headway will be made by changing from one type of packing to another. What really is required is the proper metal in the right place. A packing metal that does good work on saturated steam locomotives will not answer on a superheater. While the reverse may be true, it is not always economy to use a superheater packing metal in a packing for saturated engines. The tandem packing and equipment is the most serviceable packing and equipment for use on superheated steam locomotives. The particular make or shape of packing, outside of being a very substantial body of metal, can in most cases be left to the will of whoever is in charge. The idea of the tandem packing is that better lubrication of the packing rings is obtained by the packings retaining some of the lubricant between them when steam is shut off. The recommended practice is to use a copper-lead ring, or rings, in the first packing next to the cylinder. This is recommended on account of the packing next to the cylinder doing most of the work, and, of course, also being in the hottest place where a babbitt packing would not stand up so well; and a babbitt packing, preferably a metal containing approximately 80 lead and 20 antimony, in the second packing. This combination of metals is recommended on account of economy and also owing to the fact that this combination will not wear the rods as fast as two copper-lead packings will. While the above recommended practice is not universally used at this time, the fact remains that it has and is being used very successfully where babbitt packing rings alone would not stand up. A curious condition found is the fact that many superheater locomotives are running with babbitt packings, many of them giving very good satisfaction. The writer is of the opinion, however, that where babbitt packing is giving satisfaction on a superheated locomotive they are not getting proper superheat, at least they are not getting the highest superheat possible, which, of course, is what the superheater is for.

Here and there among a lot of superheaters there may be found some that give much trouble in keeping the piston rods packed, the packing usually melting out. Generally speaking, wherever this condition occurs, it is apparent that that particular locomotive is making superheated steam and lots of it. On such locomotives nothing but copper-lead packings will give satisfaction, and the sooner adopted the sooner peace of mind returns and trouble stops. Where single packings are used, on account of not having clearance enough to permit the use of tandem packings, the copper-lead packings will be found to be the best and the only ones that can be depended upon, and also in the end the most economical even though the first cost is considerably higher. The use of a good swab and careful attention by the engineer to keep it well lubricated will make such a packing give a very good account of itself. It is also a pretty well established fact that engineers should leave the throttle cracked when drifting, for besides helping the packing it materially helps other conditions, such as the valves, etc., in keeping them better lubricated.

In this connection, it might be pertinent to mention the fact that it will be a paying investment to keep close watch on vibrating cups, followers, springs, etc., in order that they will be in good condition at all times for a service that is very severe on packing at the best.

The Chicago, Rock Island & Pacific has been requested by the city council of Muscatine, Ia., to build a new bridge over Monroe St.

Report of the Forty-Seventh Annual Convention of the American Railway Master Mechanics' Association.

The forty-seventh annual convention of the American Railway Master Mechanics Association was held on Young's Million Dollar Pier, Atlantic City, N. J., on June 15, 16 and 17, 1914. The first session was called to order by President D. R. MacBain. The president's address was then given, extracts from which are here given.

PRESIDENT'S ADDRESS.

Past Presidents Bentley and Crawford, in their addresses to the conventions of 1912 and 1913, respectively, referred to the matter of consolidation, and each suggested the advisability of shortening the period of time that we are kept away from our business. The matter of consolidating the two organizations seems to be more remote than it ever has been since the time consolidation was first advocated. Mr. Bentley's suggestion that the two associations meet in one week, devoting Tuesday and Wednesday to the meetings of the one association, and Friday and Saturday to the other, with the two associations meeting jointly on Thursday, seems to be a splendid idea, and I think the plan outlined should be given our earnest consideration. I should not like to see this Association lose its identity as such, for the consideration of matters pertaining to locomotive design, construction, maintenance and operation, and I know that you will agree with me when I say that this Association can be of far greater benefit in the handling of such subjects now than it has been at any other time in its history; for the problems of design, construction, maintenance, and operation are vastly more intricate to-day than ever before, and the necessity of an association of this kind is so apparent that it cannot reasonably be questioned by those who are in the least thoughtful.

The question regarding the factor of safety applicable to locomotive boilers in service prior to January 1, 1912, was settled recently, and it is my belief that the agreement reached at the conference of the railroad representatives and the officers of the Government is equitable and should prove satisfactory to all concerned. On the whole, the spirit of co-operation manifested by the representatives of the railroads toward the representatives of the Federal and various state governments, in my opinion, has been of great value in associating us on a common, working plane, and I would urge that we all give to this particular phase of our business the necessary thought and co-operation in order that we may receive due recognition by the several governments of the fact that we are endeavoring to do our utmost in all things that are essential, regardless of whether we succeed at all times to their entire satisfaction.

At the present time there are numerous things in relation to design, construction, maintenance and operation that are common to nearly every railroad on this continent, and therefore it would seem that there should be prevalent something in the nature of standard practices. And, in this connection, did it ever occur to you that we have about as many different practices as we have railroads? Perhaps not quite as many, but for the sake of argument we will let the assertion stand. Is it not probable that in all things pertaining to design, construction, maintenance and operation there must be at least a few items that this Association could pass upon authoritatively and make recommendations which, if put into practice when we return to our homes, would result in much good, not only to ourselves by reason of diminishing our troubles, but also to the respective companies we serve by reducing the cost of transportation? This association, to retain its recognized position of prestige and usefulness, should divorce itself from the present plan of argument and, perhaps, from "Recommended Practice," and become the authoritative body ruling upon the subjects confronting its members, and then, by special circular, as well as in the annual report of proceedings, send out the "finished product" as a guide to its members? I fully realize, of course, that even this action would not be dominant in every particular case and entirely eliminate the idea of individual superiority and importance, but nevertheless it has been my experience that the men who really "do things" are those not blind to the fact that someone else might be in the right and they themselves in the wrong.

At the convention in 1906, President Ball told us of the increase in tractive effort during the period from 1896 to 1906. In the eight years intervening since that time wonderful changes have occurred in this respect. Comparing the average tractive effort of approximately 1000 locomotives operating on one of the important trunk lines, we find that since 1906 there has been an increase of 7600 pounds, or 26.48 per cent. In face of this large increase, it is rather laughable to think that but a few years ago we were all pretty well agreed that the limits of size of locomotives, both passenger and freight, had been reached. Nor has the limit been reached yet; we are still going ahead; the evolution of the locomotive continues, and larger and more powerful units are being produced daily, as may be evinced from the large number of Mallet and Mikado engines now running in regular road service, performing work, in the way of efficiency and economy, far beyond the fondest expectation of the most optimistic of the men who introduced these types. And last, but not least, insofar as size is concerned, comes the Triplex, the value of which is still to be determined.

It is gratifying to note that during the past five or six years more attention has been directed to the question of proper boiler proportions, and the effects of these changes have been very satisfactory in the production of unit efficiency, as well as in the reduction of haulage cost per ton mile. This I believe to be one of the wisest steps taken by the mechanical officers of the railroads in many years, and it is pleasing to note that the change is rather universal in the acquirement of new power. On older engines of quite modern design, where the boiler proportions are not quite as symmetrical as those on the power being built today, we have been able to increase the unit efficiency and decrease the fuel combustion per ton mile by the introduction of modern devices, chief among these and by far the greatest benefactor being the superheater. This, I am sure, has afforded the means of taking the longest single step in advance in locomotive service that ever has been observed on this continent. During the past few years we have overcome the difficulties attendant upon its use, and we now feel that we could not afford to get along without it. The question of lubrication and that of procuring suitable metals for packings and bushings, which at first appeared to be serious problems, now have become mere history for the most part, and those of us most skeptical in the beginning are now the strongest advocates of the superheater.

The wide extension in the use of the brick arch has proved to be another long stride toward unit efficiency and economy, and the change of sentiment that has taken place toward this device within the past five years affords a splendid exhibition of the healthiness of this association in determining the factors that contribute to the general betterment of locomotive operation.

I have a few very interesting figures showing the results of a test conducted with a Mallet engine in its three different forms, namely, the original Mallet, the same engine with a superheater, and the same engine equipped with a superheater and a brick arch. These figures represent the pounds of dry coal consumed per dynamometer horse power, and are given below:

Speed in miles Per Hour.	Original Mallet.	Mallet with Superheater.	Mallet with Superheater & Brick Arch.
12.5	4.67	3.15	2.90
15.0	4.75	3.56	3.25
17.7	4.69	3.40	3.27
Average	4.70	3.37	33.14
Per cent. saving in fuel..........		28.3	33.2

There are many other items of betterment that I should like to review with you today, would time permit, each of which has its own important function to perform in attaining the end desired—general betterment and economic results—and where these devices have been installed and properly maintained, together with good adjustment and general maintenance of the locomotive, the results are indeed gratifying.

SECRETARY'S AND TREASURER'S REPORTS.

The report of the secretary showed that the association had a membership of 1046, classified as follows: Active, 979; associate, 19; honorary, 48. The three association scholarships at Stevens Institute are at present filled and the holder of the scholarship at Purdue will graduate next year. The secretary read a change in the constitution recommended by the executive committee which was to the effect that active or associate members who have been in good standing not less than twenty years and who cease to be actively engaged in railway work may be elected honorary members; the nomination to be made by the executive committee. The secretary read a communication from the International Railroad Master blacksmiths' Association, asking co-operation in encouraging foremen to attend its convention at Milwaukee on August 18, 19 and 20.

The treasurer's report showed that the association had a cash balance of $941.51.

LOCOMOTIVE STOKERS.

The development of the locomotive stoker, though nothing notable has been observed during the past year. The committee believes most of the statements appearing in the last report have been borne out in practice, according to such observations as the additional year has permitted. It is no doubt probable some erroneous conclusions have been drawn with reference to the capacity of the stoker, relative fuel consumption and economy, before fully weighing all operating conditions in train service. A truer value of the stoker and its range of usefulness and efficiency seems to be fully comprehended by those who have taken the time to make the necessary inquiries and investigation.

Remarkable interest is being manifested in the development of loco-

motive stokers, and while many of those in service are actually doing their work, the subject is still in its infancy. The committee wishes to again refer to the difficulties surrounding the designing of a machine to suit present locomotive construction; not so much on account of the work to be performed, but the absence of choice as to arrangement, the absolute limitations of space, and the conditions under which such a machine must operate. It is believed that as time goes on, greater latitude will be given the designers, and consequently more will be accomplished, where it is preconceded that the stoker is to be a part of the locomotive. This should allow consideration being given to the working parts of the stoker along with the locomotive as a whole, and it is not improbable that when the design for the stoker is given equal consideration the locomotive will be constructed in many of its details so as to better suit, or be better adapted to, a stoker than now obtains where it is necessary to construct the stoker to suit existing designs.

STREET STOKER.

The Street stoker, which is of the scatter type, and a type having the greatest number in service (totaling 418, with some 82 on order), as now designed, handles crushed or slack coal. Some of the earlier designs, however, were constructed to handle run-of-mine coal. A number of these stokers are still in operation on passenger engines on the Chesapeake & Ohio. The engines so equipped are coming and going daily (many in pool service), performing the work expected of them, and the proper operation of the stokers with which the engines are equipped is left to the crews to which they are assigned.

CRAWFORD STOKER.

Beyond the continued improvement in detail parts, the Crawford underfeed stoker seems to be adhering closely to its original principle of construction. The record shows that there are at present 301 in service, all applied to engines on the Pennsylvania Lines West, except two on the Lines East of Pittsburgh. From all reports they are working satisfactorily. The machine, as previously described, handles run-of-mine coal, producing its best results using the higher volatile products. The report from the Pennsylvania is to the effect that they are closely observing the every-day performance of the stokers in service, so as to ascertain under which the highest efficiency is obtained, and incidentally are educating men to handle and control them to the best advantage.

HANNA STOKER.

The Hanna stoker is another of the scatter type, but handles run-of-mine coal, as described in detail in last year's report. It continues to perform its work satisfactorily, according to reports. The records show that to date there are three in operation—one on a Mallet locomotive on the Carolina, Clinchfield & Ohio, another on a Mikado on the Queen & Crescent, and a third on a Class M-2 (4-8-o type) locomotive on the Norfolk & Western. The committee is informed that there are six additional stokers to be applied to Mallet engines on the Carolina, Clinchfield & Ohio, and 15 to the same type locomotive on the Norfolk & Western.

STANDARD STOKER.

The committee's last report mentioned all stokers concerning the operation of which information had been secured. Since that time some tests of the Standard stoker have been made on the New York Central in heavy freight service, and the reports so far seem to be quite promising. The company manufacturing the stoker, like other designers, seems to be satisfied that they are working along the right lines, and such may be the case, but time and trial only can determine if they are right. A special feature claimed for the stoker is the elimination of all parts from the engine cab and deck, and the use of run-of-mine coal without previous treatment or selection. The coal is reduced to the required size by an arrangement of the feeding screw, thus eliminating the necessity of a separate crusher. As the coal gravitates to the horizontal screws it is delivered to a point about the center of the fire box—but at the back end—where another screw, in a vertical position, elevates the fuel to a sufficient height, where it is blown by steam over the fire bed. The machine is actuated by a turbine engine, which is also a departure from the conventional lines followed in other designs. A second stoker of the Standard type has been put on a Mallet engine in service on the New York Central, and three more have been secured for experimental purposes on the Norfolk & Western. Two of the latter machines will be applied to heavy freight engines of the 4-8-o type, and the third to a heavy passenger engine. The Standard stoker, like the Hanna and Crawford, differs from the Street in that it handles run-of-mine coal, whereas the Street, as now constructed, requires prepared or slack fuel.

AYERS STOKER.

Within the past year some very interesting work has been done by A. R. Ayers, general mechanical engineer of the Lake Shore, toward the utilization of the chain grate. The committee is not familiar with the details of the design, nor the progress thus far made, but understands it is not quite ready for application. The idea indeed is interesting, and is a principle your committee believes well worth exploiting. The Standard and Ayers seem to represent the most prominent work in the stoker field during the past year.

BREWSTER STOKER.

No reports of further development of the Brewster stoker have been received during the year. The statement has been made that their patents have been taken up by the Standard Stoker Company.

STROUSE STOKER.

While nothing definite has been learned concerning any new developments in the Strouse stoker during the past year, it has been said that a son of the original inventor is working on the design.

GEE STOKER.

But one stoker of the Gee design has been built to date. It is still in service on a Class H-6 (2-8-o type) locomotive on the Pennsylvania Lines East, and is reported as giving good results. It is still considered in an experimental stage.

ELVIN STOKER.

With the construction of a full-size working model of the Elvin stoker, which is now ready for application, a distinctly new principle is offered. While it properly belongs to the "scatter" or "overfeed" group, it may be referred to as the shovel type in contradistinction to the rest. The machine is attached to a casting similar to and is bolted to the back head of the boiler—the same manner as the fire-door front. It is made up of two shovels, one operating to the right and the other to the left; under full control, distributing coal regularly and evenly over the bed of the fire, as might be expected under expert hand firing.

The drum, or stoker mechanism, operates at 20 revolutions per minute when shoveling 12,000 lb. of coal per hour. The operation is entirely mechanical, no steam being used in distributing the coal.

RAIT STOKER.

The Rait stoker is a patent of Geo. B. Rait, of Minneapolis. The committee has not seen any working drawings, but understands from the inventor that most of the machinery is below the deck of the cab. It is also mentioned as an interesting feature that it can be handled as either an underfeed or a scatter type. As yet there are none in operation. The committee further understand from the inventor that he has some new designs and improvements pending in the Patent Office, and will soon have working drawings ready for exhibition. This stoker is therefore undergoing development.

The Norfolk & Western submits the following performance figures for the Street stoker:

All failures chargeable to stokers:	
Total number of machinery failures in fair service	43
Total number of failures due to flaws and defects in machinery	4
Total number of failures due to machine becoming clogged with foreign matter	31
Total number of shop or bad-workmanship failures	19
Total number of crew failures, or failures due to improper handling, resulting in low steam	48
Total number of failures due to improper lubrication as a lack of attention	20
Total failures	165

Total mileage made by engines equipped with stokers	2,296,803
Total stoker failures as above	165
Miles per stoker failure	13,920
Total cost for labor and material chargeable to stokers	$12,179.22
Cost of stoker repairs per 100 miles, cents	.53

Engines 1303 and 1311 have not as yet had a stoker failure charged to them, having made 36,089 miles and 35,778 miles, respectively, since the engines were put in service new in April, 1912.

The Baltimore & Ohio reports that the Street stokers in service on that road are making 44,300 miles per failure chargeable to the stoker proper. It may be of interest to mention in connection with the apparent difference in the figures submitted by the Baltimore & Ohio and the Norfolk & Western showing mileage per stoker failure, that the Baltimore & Ohio figures are computed on the basis of the number of machinery failures in fair service and does not include delays caused by the stoker not being properly operated by the engine crews. On the same basis, as can be quickly seen by referring to the tabulation, the mileage per failure on the Norfolk & Western would be equal to 53,414 miles, which is very close.

The following data are submitted by the Pennsylvania Lines West of Pittsburgh, giving some interesting information in connection with the performance of the Crawford stoker, including *all* trips of all stokers from the experimental installation to this date:

	As Reported Jan. 1913.	As Reported Jan. 1914.
Total number of trips	26,693	98,181
Number of trips—100 per cent	16,445	55,913
Number of trips— 99 per cent	262	335
Number of trips— 98 per cent	402	723
Number of trips—95-98 per cent	1,367	3,865
Number of trips—90-95 per cent	1,577	5,352
Number of trips—85-90 per cent	560	1,861
Number of trips—80-85 per cent	715	2,963
Number of trips—75-80 per cent	962	4,086
Number of trips—70-75 per cent	305	1,306
Number of trips below 70	4,098	21,787

The Norfolk & Western submits the following data for the Hanna stoker, which was put in service February 11, 1914:

Number of days in service.. 48
Number of trips.. 37
Number of 100% or successful trips.....................32, or 86%
Number of failures on road requiring hand firing for a portion or completion of trip to be made pending repairs to be made.... 5

During the year 1912 there were 165 Street stokers in operation. During the year 1913 there were 253 additional stokers installed, making a total of 418 in operation. They are distributed as shown in the table.

Rroad.	Consolidation	Mallet	Mikado	Mt. Type pass	Decapod	Centipede	Pac. pass	Total
L. S. & M. S.	....	3	....	....	....	....	....	3
N. & W.	2	90	....	....	....	....	....	92
C. & O.	....	14	50	3	....	....	6	73
B. & O.	1	24	161	....	1	....	....	193
Virginian	....	6	1	....	....	....	....	7
B. R. & P.	....	5	1	....	....	....	....	6
H. V.	....	....	17	....	....	....	....	17
A. T. & S. F.	....	1	....	....	....	....	....	1
D. M. & N.	....	8	....	....	....	....	....	8
E. P. & S. W.	1	....	5	....	....	....	....	6
C. B. & Q.	....	....	1	....	12	....	....	13
Erie	....	....	....	....	....	1	....	1
Total	4	155	236	3	13	1	6	418

CRAWFORD STOKER.

During the year 1912 the Pennsylvania Lines West had 144 double underfeed Crawford stokers in operation. The Pennsylvania Lines East had 2, making a total of 146. During the year 1913, 155 additional stokers were applied, making a total of 301:

Type of Stoker	Class of Locomotives	As Reported in Jan., 1913	As Reported in Jan., 1914
12	K2	1	1
12	K2as	26	26
12	K3s	..	30
13	H8c	10	10
13	H8cs	1	1
14	H6a	5	5
15	H6a-b	20	20
16	H6a	1	1
17	H8c	1	1
19	B29	1	1
22	H8c	54	54
22	H8cs	32	32
22	H10s	..	110
23	H6a-b	1	2
25	K2	..	4
25	K2as	2	3
Total		155	301

COMPENDIUM.

Type of Stoker	No. of Stokers in Service	No. of Stokers on Order
Street	418	82
Crawford	301	..
Hanna	3	21
Standard	2	3
Gee	1	..
Ayers	1	..

During the past year opportunities have been afforded to observe a much larger number of stokers in service, many of them working in pool runs, which rather strengthens the belief that they are capable of going along, faring under the usual average attention given a locomotive, without developing prominent or serious defects that result in materially increasing terminal turning time. The most natural inquiry would refer to the durability of such machines as a whole. It goes without saying that the stoker, with all of its parts, is susceptible to wear, but those in service have no doubt surpassed the general expectation. They require attention and repairs, but the cost figures are not excessive, considering the stage of development through which they are passing. There is no particular work the fireman can do in the way of making repairs on the road, but attention on their part, though slight as a rule, is beneficial and helpful toward preventing failures. The performance of the stokers in service during the past year has served to show what must be met in the way of durability, and what is necessary to withstand the operating strain. Alterations are now in progress looking toward stronger and more durable machines, which should in turn favorably affect the cost of maintenance.

It is noteworthy that when the demands upon the boiler are fairly uniform, permitting a regular feed of coal, the operation of the stoker practically takes care of itself, but, in the absence of automatic manipulation, manual control does not always result in efficient regulation of the fire; on the contrary, the boiler, if anything, if allowed to blow off more than necessary, not only under working conditions, but quite freely when the demands are reduced, and when the engine is not using steam, carrying with it some waste of fuel, due, however, to want of attention. Then, again, there is some tendency, through neglect, to allow the fire to get low while standing on the road, making rebuilding necessary; still with the stoker the fire is readily revived, and little, if any, time is lost thereby.

It is still a mooted question as to whether it is economical to use run-of-mine or screened coal. Both schemes are worthy of consideration, depending upon local conditions, and in the same way that it is necessary a road contemplating the use of stokers can only work out the advantages to be gained after taking into consideration the physical character of the road, the size of engines, and the tonnage now being handled, it should ascertain whether upon taking into account all local conditions it is more profitable to use the screened or run-of mine coal.

As for fuel consumption, it has been pretty clearly shown that the amount of coal used by the stoker (as to some extent obtains in hand firing) largely depends upon the physical character of fuel rather than the heat value, so long as the latter is within a reasonable range. The establishment of data to show the relative fuel consumption by hand firing as compared with the operation of the stoker was sought, but so far there seems to be very little statistical information in such shape as to permit a general ready comparison to be made. At the same time some very complete tests have been conducted under a range of operating conditions, character of fuel, etc., but none of them permit conclusions to be drawn without taking into consideration the character of fuel and conditions under which the highest efficiency was obtained. In order to make a true comparison, therefore, it is necessary to ascertain and fully account for local conditions, character and price of fuel.

This year's experience seems to give color to the belief that the stoker is not necessarily a coal-saving device, but that its advantages tend in other directions. Dynamometer tests have shown that the capacity of the locomotive is increased, and according to further reports made by the Pennsylvania, an increase approximating 5 per cent in trainload with the Crawford stoker for an equal amount of fuel hand-fired has been obtained. The Baltimore & Ohio reports an increase in train tonnage from 5 to 10 per cent. In both, however, it should be remembered that the differences indicating increased capacity were largely dependent upon local conditions. The Hocking Valley advises, in connection with the Street stoker, that they are using fuel known in the Hocking Valley district as "coarse slack." It is coal that passes through a ¾-inch mesh screen. As for fuel consumption, the Hocking Valley reports that no definite tests have been made, adding, however, that their fuel record showing consumption of coal per engine per 1,000 miles does not indicate there has been any reduction in fuel per 1,000 ton-miles, but that the grade of coal used is purchased at about 40 per cent less than run-of-mine.

In tests made on the Norfolk & Western it was found with one of the scatter-type stokers that there was a considerable increase in coal consumption using Pocahontas slack as compared with Pocahontas run-of-mine hand-fired. The difference in quantity of coal consumed as between screened coal stoker-fired and run-of-mine hand-fired was found to diminish as the physical character approached the run-of-mine, or a product containing a less amount of fine material. While standing along the road it is quite necessary, as can be readily appreciated, to occasionally watch the fire in order to keep it in proper condition and in readiness, especially where slack fuel is used, as the depth of the fire is relatively lighter, but it is not materially unlike what is needed for efficient and economical hand firing.

As referred to in another part of this report, the fuel consumption seems to vary almost in proportion to the physical fineness of the coal used in stoker firing with the scatter-type machines, a percentage of the lighter material being evidently drawn through the tubes by the heavy action of the draft. Using Pocahontas nut stoker-fired and run-of-mine hand firing, the consumption figures are not far apart. From this it would appear that with the higher volatile coals containing a smaller amount of fine product, the consumption of fuel as between hand-fired and stoker-fired should be very close. It also seems evident that though the consumption increases as the coal becomes finer in character, the stoker is better able to maintain steam with it than might be secured on an average hand-fired.

The committee has not had the opportunity to make extensive investigations, but has received reports that when the feeds are not forced beyond the limits of complete combustion, the reduction in smoke is longer maintained with the underfeed than with the scatter types, on account of the fuel being delivered up through the bed of the fire as combustion progresses, under conditions of service and character of fuel suitable to their present stage of development.

It is also understood that the New York Central have made some investigations in connection with the use of pulverized fuel on switching locomotives, and they are still investigating the subject, but up to the present time it is quite experimental. The Pennsylvania has also given it some consideration, but advise they have nothing of interest to offer.

Committee: A. Kearney (Chairman), M. A. Kinney, J. H. Tinker, I. B. Thomas, J. T. Carroll.

Discussion.

J. T. Carroll—The tonnage on our stoker-fired Mikado locomotives runs from 5 to 10 per cent greater than on the same locomotives

when hand-fired. Also during the hot weather when we used to have trouble to keep good firemen on hand-fired engines. We had very little trouble of this sort on stoker-fired engines.

C. H. Hogan—We have two Standard stokers on our lines and the reports show that their performance is beyond expectations.

C. F. Street—Practically no change has been made in the Street stoker during the past year. We are able to use successfully any coal that could be used efficiently with hand firing, and are successfully using all grades of coal.

D. F. Crawford—There is no longer any question as to the possibility of firing a locomotive with a stoker. The amount of fuel used by a stoker depends on the man who handles it. The only way to determine the coal consumption is by a long series of observations and on trains of the same weight. Our stokers handle coal as it comes from the mine and the lumps are much larger than 6 inches in size.

E. A. Averill—With a hand-fired locomotive the engineer's eyes are constantly on the steam gage, but with a stoker engine he learns that the gage is always at the same point. Therefore, he takes more interest in how much power he can get out of the locomotive, and the results are often surprising.

T. R. Cook—The stoker assists us to a great extent in hiring and retaining firemen. We have no difficulty in getting firemen to handle the stoker successfully.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

CASTLE NUTS—STANDARD.

Page 485. Sheet M. M. 15.

At the 1913 convention the subject was presented considering the modification of the table of standard proportion of castle nuts in order to provide for steel nuts with the height of the U. S. Standard for rough nuts. The details of this were referred by the executive committee to this committee.

At the request of the chairman, laboratory tests were made in more or less detail of steel castle nuts made in full proportions to agree with the present standards excepting in the height of the nut, which was made the same as the U. S. Standard rough nuts. Also the threading for the bolts was extended to the top of the castellation. These tests were made by the New York Central Lines, the Pennsylvania, the Atchison, Topeka & Santa Fe, and the Chicago & North Western. The nuts were screwed onto mild-steel bolts and the combination pulled to destruction. In the majority of the cases the bolt failed in the thread just below the nut, and in cases where the nut was at all originally too loose on the bolt, the threads on the bolt usually stripped.

The results of these tests are briefly summarized in the table, from which it is seen that for working pressures ordinarily used, these steel nuts have ample proportions.

Nominal Diam. Bolt.	Nominal Area Bottom Thread Sq. In.	Total Strain—Lbs. Estimated.		Acti al Strain.		
		@7 000 Lbs.	@10 000 Lbs.	Min.	Max.	Average.
½"	.125	875	1 250	8 100	8 640	8 370
¾"	.3	2 100	3 000	20 030	21 000	20 515
⅞"	.42	2 940	4 200	24 830	29 750	27 760
1 "	.55	3 850	5 500	30 850	42 370	36 600
1⅛"	.69	4 830	6 900	38 910	52 210	47 000
1¼"	.78	5 460	7 800	49 550	68 850	59 000
1½"	1.28	8 960	12 800	72 910	78 600	75 260
2 "	2.3	16 100	23 000	....	141 950	....
2½"	3.7	25 900	37 000	....	198 400	....

Taking as a basis the rough diameter of U. S. Stndard nuts, the rough thickness of U. S. Standard nuts for sizes 1 inch and over and the present thickness of thin castle nuts for sizes ⅞ inch and smaller; the proportions of the present slots for thick and thin castle nuts; extending the bolt-threading to the end of the bolt to obtain the full benefit of the threading in the castellation and maintaining the present sizes of cotter and taper pins and holes, your committee presents the attached table of proportion for consideration.

SPECIFICATIONS FOR STEEL TIRES—RECOMMENDED PRACTICE.

Pages 486-489.

A member calls attention to the fact that in the physical test of steel-tire specimens the elongation is to be measured in 4-inch and that general practice and the American Society for Testing Materials use 2-inch. He further recommends the following of the practice of the American Society for Testing Materials.

The committee concurs in this recommendation and suggests changing the table in Section 7, on page 487, to read as follows:

Class	Tensile Strength Lbs. per Sq. In.	Elongation per cent in 2 Inches	Reduction in Area per cent
(A)	105,000	12	16
(B)	115,000	10	14
(C)	125,000	8	12
(D)	The elasticity shall be at least 50 per cent of tensile strength.		

A member suggests that the wedges should have the downward projecting lips shown at the front of those wedges, the same as are shown for the 4½ by 8 inches on Sheet M. M. 7.

The committee concurs and secretary is instructed to correct the drawings.

3¾	by	7-inch Journal.	Sheet M. M. 4.
4¼	by	8-inch Journal.	Sheet M. M. 7.
5	by	9-inch Journal.	Sheet M. M. 10.
5½	by	10-inch Journal.	Sheet M. M. 13.

A member recommends that the use of solid wedges only be permitted and the note allowing the use of skeleton wedges be omitted.

The committee concurs in this suggestion only so far as 5 by 9-inch and 5½ by 10-inch journals are concerned.

SPECIFICATION FOR CAST-IRON WHEELS—RECOMMENDED PRACTICE.

Pages 498-504. Sheets M. M.—E, F and G.

A member calls attention to the title and note under cut on sheet E, advising that in order to agree with the M. C. B. specifications for cast-iron wheels, and also to conform to the loading for which the 4¼ by 8-inch journal axle was designed, this should read "maximum gross weight not to exceed 95,000 pounds," instead of "112,000 pounds."

The same correction is suggested for the title of the specifications, page 498, and the table of weights on page 500.

The committee concurs and recommends the suggested correction.

GAGE FOR MEASURING STEEL WHEELS TO RESTORE CONTOUR—RECOMMENDED PRACTICE.

Page 511. Sheet M. M.—C.

A member suggests adding the words "to remove in order" between the words "necessary" and "to restore."

The committee concurs and secretary is instructed to add to the text.

CHECKING FORMULAE FOR MAIN AND SIDE RODS—RECOMMENDED PRACTICE.

Pages 527-530.

A member suggests advancing this to standard.

The committee concurs in this recommendation.

NEW BUSINESS.

A member suggests that the M. C. B. journal box and contained parts for 6 by 11-inch journal axles be adopted as Recommended Practices.

The committee concurs in the suggestion.

A member suggests that the plate numbers and titles be printed on the outside lower right-hand corner of the folded sheets, to facilitate finding the desired plate.

The committee concurs and secretary is instructed to arrange.

Under instructions, the committee was to rearrange all specifications for material to conform to the outline adopted by the Master Car Builders' Association. Believing that all specifications should at the same time be revised to agree with the latest recommendations of the Master Car Builders' Association and the American Society for Testing Materials, especially the latter, the committee would refer the matter to the convention for further instructions.

Committee: W. E. Dunham (Chairman), R. B. Kendig, M. H. Haig, A. G. Trumbull, C. D. Young.

The sections of the report on maximum and minimum flange-thickness gage, and rearrangement of specifications was referred back to the committee for further action. The balance of the report was referred to letter ballot.

SAFETY APPLIANCES.

D. R. MacBain, chairman of the committee, stated that no written report had been prepared. Progress in equipping locomotives had been satisfactory and the work was practically completed. The report was received and approved.

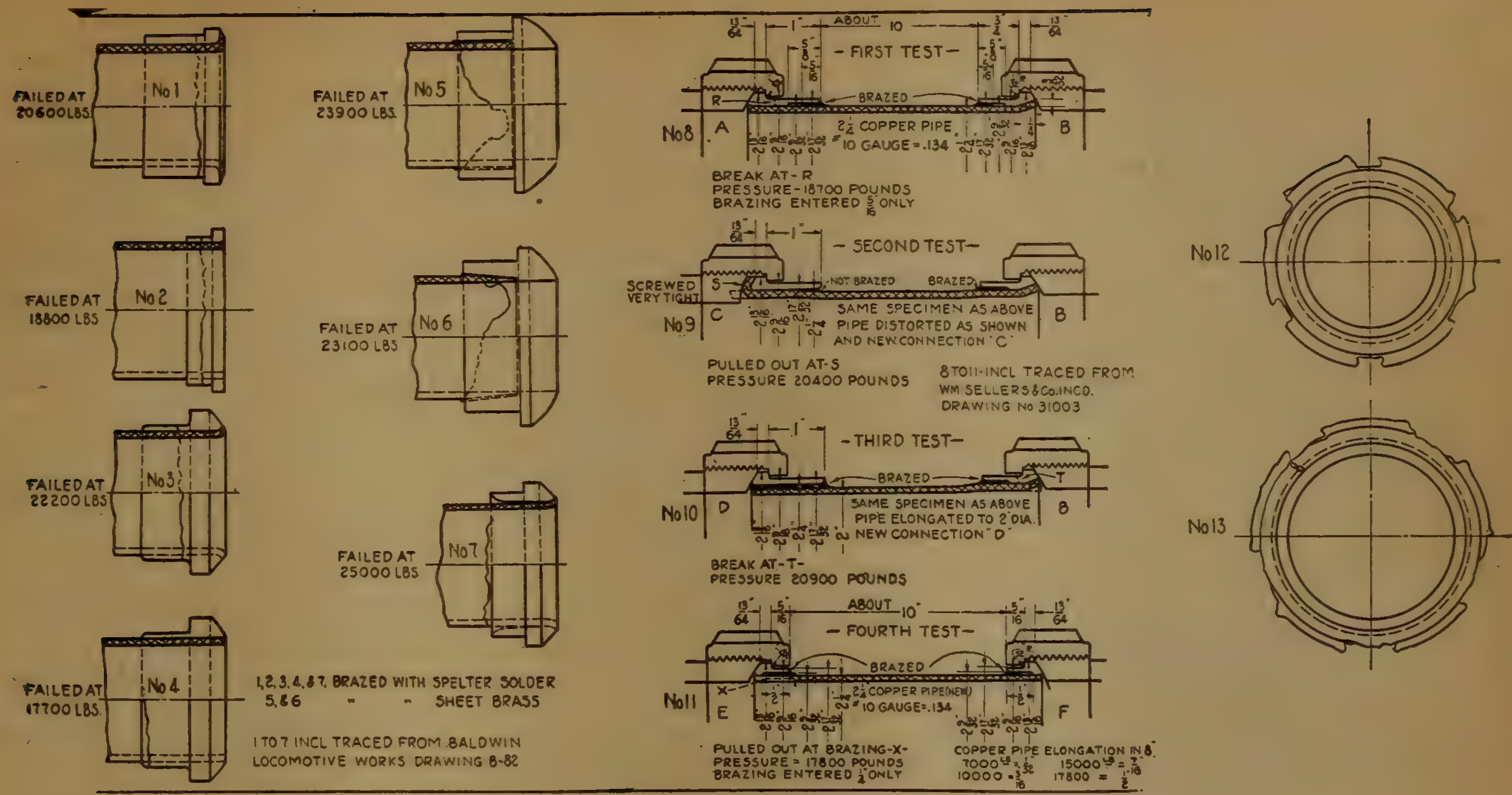
DIMENSIONS FOR FLANGE AND SCREW COUPLINGS FOR INJECTORS.

By O. M. Foster, Master Mechanic, L. S. & M. S. Ry.

The arrangement of injector pipes generally employed in this country embodies the use of a copper pipe between the turret and the steam connection on the injector body, a wrought-iron or copper pipe between the delivery connection of the injector and the boiler check, and a wrought-iron pipe or cast-iron goose neck between the tank-hose coupling and the suction (or water) connection on the injector body. It has been customary also to use on the ends of copper pipe a ball joint brazing ring and on the ends of iron pipe a pipe union or ball joint nipple, in either case completing the connection by the use of a threaded coupling nut.

In developing the subject matter for this paper, the writer sent out inquiries to a large number of railroads requesting data covering designs and proportions of brazing rings, coupling nuts, pipe unions, etc., in use, the replies indicating that in most cases manufacturers' standards for these parts were being followed. Upon request, each of the injector manufacturers furnished a very complete set of detail drawings covering the parts entering into the make-up of the pipe connections used with his various types and sizes of injectors.

The writer desires to call attention to some tests on brazed connections which were made during 1913, I believe, at the instance of a committee of injector manufacturers, S. L. Kneass, chairman. The nature and results of these tests are shown in the illustration.



Tests on Brazed Connections.

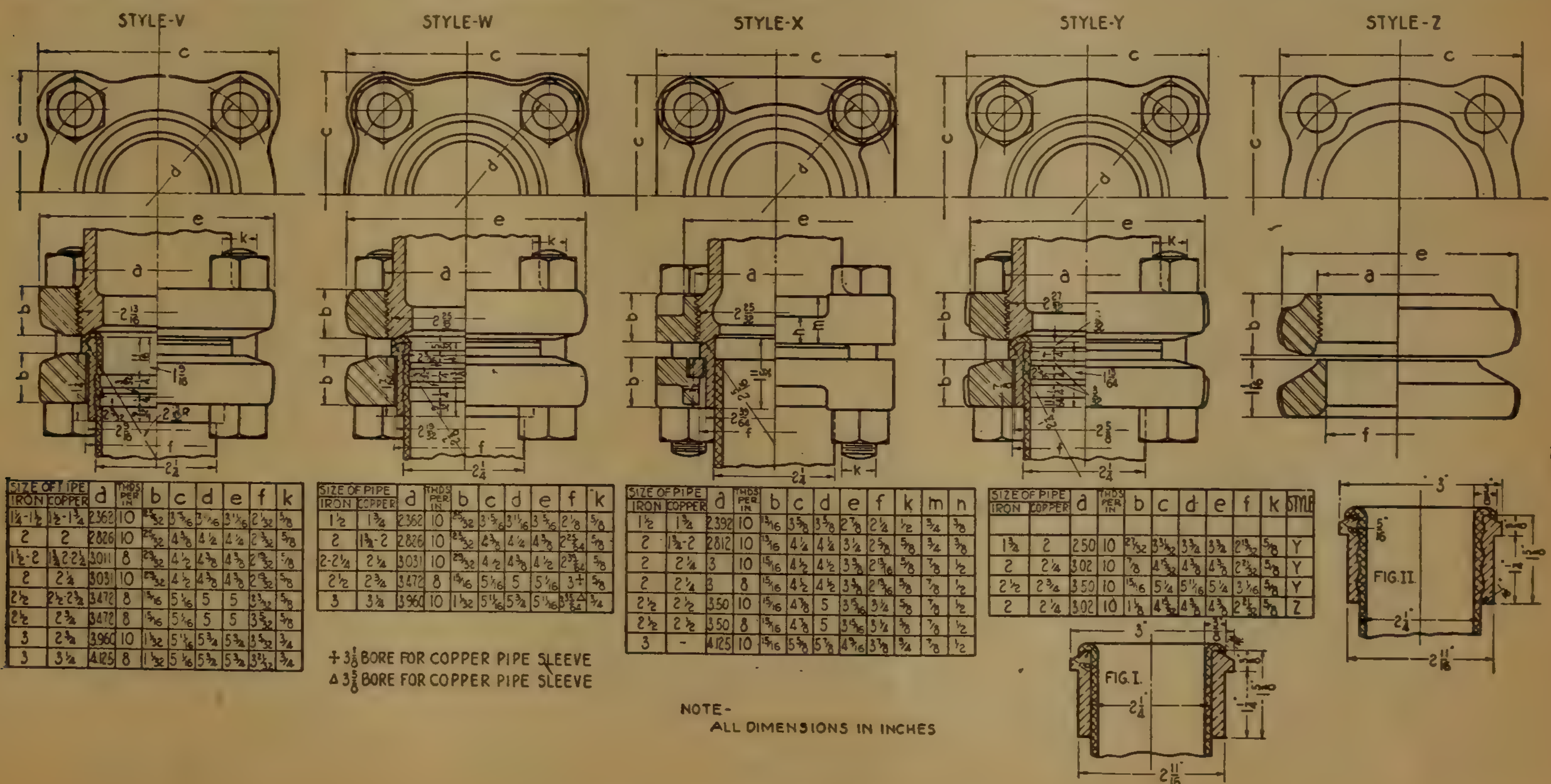
A series of tests was conducted on a 100,000-pound Emery testing machine at the works of Wm. Sellers & Co., Inc. Tests were made on short lengths of 2¼-inch copper pipe with brazed connections at each end held against concave ball seats by coupling nuts. Results and manner of failure are shown on the illustrations. It was stated in connection with these tests that in each of these instances the copper pipe showed a marked elongation reducing in diameter from ⅛ to $\frac{3}{16}$ inch before a failure of the joint. When it is considered that the pressure on a 2¼-inch copper pipe carrying 200 pounds steam pressure is approximately 600 pounds, the above figures covering actual pressures at failure would indicate an ample factor of safety in a carefully brazed joint.

It is a fact generally accepted, however, that the method of brazing and the care with which a brazing operation is performed, play an all-important part in the results obtained as to service and reliability, the more so on account of the fact that it is not possible to determine by inspection just what percentage of strength the brazed connection may be expected to develop.

Possibly with the idea of overcoming the element of uncertainty appertaining to the strength of a brazed connection, there has been developed during the past year a so-called "Mechanical Joint" for copper pipe. This connection consists merely of a beading ring or sleeve through which the copper pipe is extended and beaded over on the ball collar to form the ball joint seat. (See illustration.)

On this plate is shown the manner in which the copper pipe is applied to the beading ring, the application differing slightly as between the manufacturers. There has recently been put on the market a machine for mechanically rolling and beading the copper pipe into the ring.

Where there is not sufficient work of this kind to justify the installation of a mechanical pipe-beading machine as described above, the work can be done with a set of hand tools similar to those shown in the illustration. The sequence of operations is as indicated on Tools 1, 2 and 3, after which the expanding tool is used, providing the application is being made to groove rings. As to this particular feature, there is some reason to question the real necessity for grooving the rings, and the writer has been given to understand that one of the large locomotive companies is making the application by merely rolling the pipe with a plain beading ring and beading the copper pipe over to form the ball joint seat.



Size of Pipe Iron	Size of Pipe Copper	d	Thds per in	b	c	d	e	f	k
1¼-1½	1½-1¾	2362	10	25/32	3 5/16	3 11/16	3 11/16	2 1/32	⅝
2	2	2826	10	25/32	4⅜	4½	4½	2 3/32	⅝
1½-2	1¾ 2-2¼	3011	8	29/32	4½	4⅜	4⅜	2 9/32	⅝
2	2¼	3031	10	29/32	4½	4⅜	4⅜	2 9/32	⅝
2½	2½-2¾	3472	8	15/16	5 1/16	5	5	3 3/32	⅝
2½	2¾	3472	8	15/16	5 1/16	5	5	3 5/32	⅝
3	2¾	3960	10	1 1/32	5 11/16	5¾	5¾	3 5/32	¾
3	3¼	4125	8	1 1/32	5 1/16	5¾	5¾	3 21/32	¾

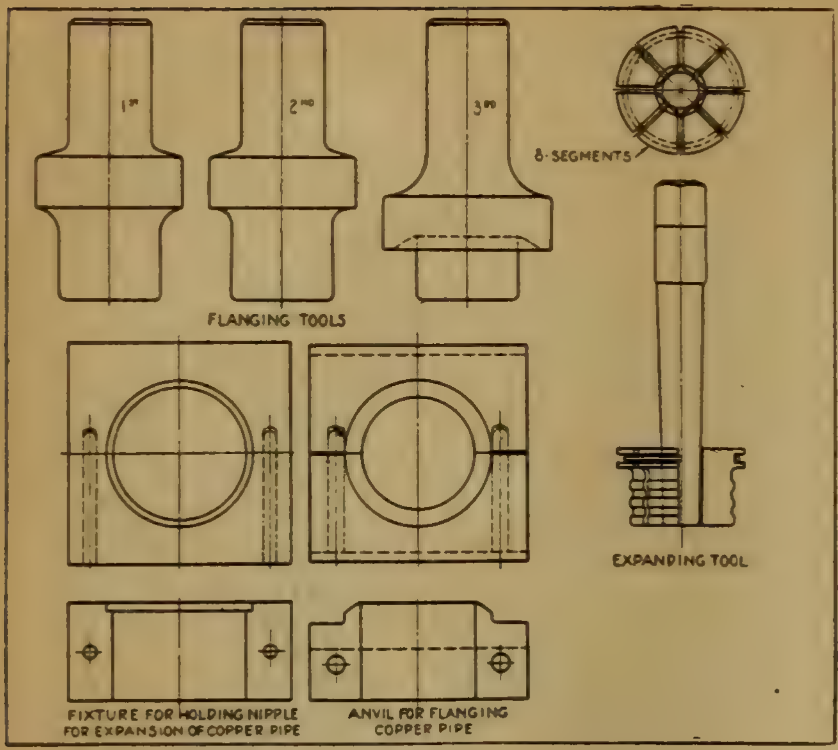
Size of Pipe Iron	Size of Pipe Copper	d	Thds per in	b	c	d	e	f	k
1½	1¾	2362	10	25/32	3 5/16	3 11/16	3 5/16	2⅛	⅝
2	1¾-2	2826	10	25/32	4⅜	4¼	4⅜	2 25/64	⅝
2-2¼	2¼	3031	10	29/32	4½	4⅜	4½	2 39/64	⅝
2½	2¾	3472	8	15/16	5 1/16	5	5 1/16	3 +	⅝
3	3¼	3960	10	1 1/32	5 11/16	5¾	5 11/16	3 35/64 Δ	¾

+ 3⅛ BORE FOR COPPER PIPE SLEEVE
Δ 3⅝ BORE FOR COPPER PIPE SLEEVE

Size of Pipe Iron	Size of Pipe Copper	d	Thds per in	b	c	d	e	f	k	m	n
1½	1¾	2392	10	13/16	3⅝	3⅝	2⅞	2¼	½	¾	⅜
2	1¾-2	2812	10	13/16	4¼	4¼	3¼	2⅝	⅝	¾	⅜
2	2¼	3	10	15/16	4½	4½	3⅜	2 13/16	⅝	⅞	½
2	2¼	3	8	15/16	4½	4½	3⅜	2 13/16	⅝	⅞	½
2½	2½	350	10	15/16	4⅞	5	3 15/16	3¼	⅝	⅞	½
2½	2½	350	8	15/16	4⅞	5	3 15/16	3¼	⅝	⅞	½
3	-	4125	10	15/16	5⅝	5⅞	4 9/16	3⅞	¾	⅞	½

Size of Pipe Iron	Size of Pipe Copper	d	Thds per in	b	c	d	e	f	k	Style
1¾	2	250	10	27/32	3 31/32	3¾	3¾	2 15/32	⅝	Y
2	2¼	302	10	⅞	4 15/32	4⅜	4⅜	2 21/32	⅝	Y
2½	2¾	350	10	15/16	5¼	5 11/16	5¼	3 1/16	⅝	Y
2	2¼	302	10	1⅛	4 15/32	4⅜	4⅜	2 21/32	⅝	Z

Flanged Connections for Injector Piping.



Hand Tools for Beading and Expanding Copper Pipe.

Along with the mechanical copper-pipe connection mentioned in the preceding paragraph has been developed the use of flanged connections as illustrated. A large number of new locomotives built during the past year have been equipped with these connections throughout the injector piping. The various styles in use and detail proportions are shown on this drawing. It will be noticed that while the general design of the flanges shown thereon is very similar, the threading varies slightly as to the diameter over the thread, Column "A." As mentioned in the case of coupling nuts, this feature, of course, offers a real hindrance to complete interchangeability.

In the matter of service, as a general proposition, the flanged connection seems to be giving entire satisfaction. The Lake Shore & Michigan Southern has had for some time a number of locomotives equipped throughout the injector lines with these connections. We have experienced no trouble whatever to date, and there is every indication that this connection is going to eliminate entirely the many undesirable features necessarily connected with the use of coupling nuts and that the mechanical pipe joint, while providing fully as good a joint as the brazed connection, has the added advantage that it can be thoroughly inspected.

Discussion.

J. F. De Voy—I have told our purchasing department to give especial consideration to the pressure under which injectors, sleeves and nuts are to operate. I believe the pressure should always be specified. I move that this subject be assigned to a committee to prepare a standard and recommended practice.

This motion was carried.

USE OF ELECTRIC MOTORS IN RAILWAY SHOPS.

By B. F. Kuhn, Asst. M. M., L. S. & M. S. Ry.

Before taking up the discussion of the different types of motors it might be well to state that no hard and fast rule can be laid down as to just what system should be used in any particular shop until the local conditions at that particular point have been thoroughly studied and analyzed. Before adopting either the alternating-current or direct-current system the actual cycle of operation of each individual machine must be carefully considered before a selection is made.

We will first discuss the direct-current system, and as we are considering direct-current for railroad shop service our voltage is automatically established for us, as 500 volts direct-current is unsuitable for use on account of its tendency to hang on after an arc has once been formed, and the severity of a flash, shock or burn that an attendant might receive, and 110 volts is too low a voltage, on account of the amount of copper required and also on account of brush, commutation and contact requirements of the motors, controllers, etc., 220 volts seems to be the ideal voltage for direct-current motor drive and where the load is a mixed load of motors and lighting, three-wire direct-current generators can in many cases be used to advantage. The three-wire direct-current distribution also has its advantages for motor drive in that a wide range in speed can be secured and the motor will be operating very efficiently at all times.

The type of motor to use in any particular case must necessarily depend on the operation to be performed, thus on cranes and hoisting work the motors should in most cases be series wound, but there are some cases in hoisting and conveying work where it is necessary to use either a compound winding or an interpole motor as it is possible under certain conditions for a straight series-wound motor to run away with a light load, and this would not be possible where the motor is provided with a shunt winding to prevent the speed of the motor reaching the danger point. This type of motor is also suitable for use on transfer-tables and turntables.

Then there are other operations which require a heavy starting torque from the motor and when in operation requires that the motor drop off in speed as the load comes on, such a cycle of operation, for instance, as occurs on a punch or shear, or any other tool provided with a fly-wheel, and for this class of service a compound-wound motor should be used.

Then we have other drives which require comparatively small starting torque but require constant speed after being put in operation, such as driving line shaft or any similar operation, and for this class of drive a shunt-wound motor should be used.

In applying motors to machine tools you must again carefully consider the cycle of operation before selecting the winding for a motor and many of the motors used on machine tools are combinations of the three different types of motors described above. On some machine tools a small amount of variation is sufficient and increases in speed from 10 to 15 per cent may be secured on the straight shunt motors, but where the range in speed would amount to 2 to 1, 3 to 1, or 4 to 1, motors for such operation should be of the shunt-wound interpole type.

These motors commutate very successfully over the whole range in speed.

Wherever a cycle of operation is peaky as in the case of a planer, motors of the interpole type should be used. Just to point out what can be done in this matter of speed variation, I would state that there are in use today motors of 100 h.-p. capacity that have a range in speed from 100 r. p. m. to 1,200 r. p. m. This variation in speed being secured without keeping in service any series resistance.

The direct-current motors of the compound wound, shunt, and interpoles types are generally provided with starting devices equipped with overload and no voltage release coils, this being a simple and effective means of protecting the motors and tools from injury due to an overload or to the failure of power and its sudden restoration to the line before an attendant might have an opportunity to cut the motor out of circuit.

Direct-current machines have their commutators and brushes which require care and attention, but commutator trouble has been reduced considerably owing to the fact that motor manufacturers have adopted one method or another to increase the commutating capacity of their motors.

From the foregoing it will be seen that the direct-current system has certain advantages particularly in its flexibility, for it is possible to secure a direct-current motor that will efficiently meet almost every conceivable cycle of operation.

The alternating-current motors are divided into three general divisions, namely, the short-circuit type induction motor, the slip-ring type induction motor and the synchronous motor. The short-circuit type induction motor requires from $3\frac{1}{2}$ to $4\frac{1}{2}$ times full-load current from the line while developing full-load torque at starting. The slip-ring type induction motor will draw $1\frac{1}{2}$ times full-load current from the line while developing full-load torque at starting, and the synchronous motor will draw approximately three times full-load current from the line while developing three-tenths of full-load torque. The short-circuit type induction motor does not lend itself to variations in speed as does the shunt-wound direct-current motor and it is, therefore, suitable for constant speed operation only.

The resistance of the motor, however, may be varied so as to give almost the same characteristics as the compound-wound direct-current motor. This type of motor is especially adapted to punches, presses, etc., of moderate sizes, but there are cases where extremely large presses are used where it is desirable to use the slip-ring type induction motor rather than the short-circuit type.

The slip-ring type induction motor is used for hoisting, conveying, cranes, etc.

The beauty of the short-circuit type induction motors is that it has no moving contacts, the only rubbing parts being two bearings.

The short-circuit type alternating-current motors are normally also provided with no voltage release coils in their starting devices and are also provided with overload release coils or fuses.

The series-wound direct-current and slip-ring type alternating-current motors are also provided with fuses or circuit breakers, as the case may be, depending upon the class of work they are being called upon to do.

Other features that have been developed for different controls are the remote control which allows the operator to start or stop a motor which may be located some distance away.

Then we have the master-type controller in which the operator simply operates the master control and the controller itself is operated by electromagnets, thus relieving the operator of all the manual work. There has also been developed the push-button type controller, which simply requires that the operator to start a machine press a button and the machine will automatically come up to speed, the current being limited at all times by the controller so that there is no unnecessary jar or strain as the tool starts from rest and comes up to its normal speed.

In the woodworking department in many cases the motors can be direct connected to the machines, and in most cases high-speed motors can be used. If direct-current motors are used for this class of service they should be shunt wound and entirely enclosed, and the starting box enclosed in metallic case lined with asbestos.

If the short-circuit type induction motor is used for this class of service they need not be dustproof, but the bearings should be dustproof and arrangements should be made to have the sawdust and shavings blown out of the motors at regular intervals and the motors should be provided in large sizes with oil-immersed compensators, and in small sizes where they are thrown directly across the line the starting switches should be enclosed in asbestos-lined metallic cases.

As a general thing motors in the woodworking department should be provided with shaft extensions on both ends, for there are many cases where it is important that each machine be provided with its own blower for carrying away the sawdust.

Where machines are equipped in this way with their own individual blowers a great saving is effected as the blower is in use only during the time that the machine is in service, whereas if one common blower is used for the whole woodworking department the load is practically the same, whether a few machines are in operation or all the machines in operation.

Individual blowers are saving some woodworking departments a steady load of between 40 and 50 h.-p.

Motors have been made for almost every conceivable method of mounting: floor, wall, ceiling, vertical and even for back-gear drive; they have also been used for belt, chain and rope transmission and also gear drive, and in still other cases the motor shaft has been direct coupled to the driven shaft. Motors have been made of the open type, semi-enclosed and dustproof type. They have been provided with bronze bearings, babbitt bearings and ball bearings. Motors have been furnished of two-bearing type and of three-bearing type. For gear driving 20 h.-p. is about the limit for two-bearing motors and there are some cases where even motors of 15 h.-p. should be provided with a third bearing in order to properly support the shaft, for as a general rule standard motor shafts are not heavy enough to stand the shocks met with in gear drives.

In actual practice it has been determined by experiment that the friction loss from engine to tool where shop is equipped with line-shaft drive ranges from 30 to 60 per cent, and in some cases the losses have exceeded 60 per cent.

The losses in transmitting power electrically from engine to tool in the case of a shop equipped with individual motors for each tool seldom exceeds 30 per cent.

But of course this is not the only advantage in the case of the individual motor for each tool. Take the case of a machine-shop containing a large number of tools at a time when you wish to operate only a few tools, the line shaft and friction losses are practically the same as they are when all tools are in use. While in a shop with each tool provided with its own motor these friction losses are entirely eliminated.

Then again, in the case of the shop depending upon line-shaft drive, if anything goes wrong with your main belt or your line shaft, all of your tools are put out of service, while in case of tools equipped for motor drive this does not occur.

Even going back to your prime movers in the case of belt transmission and line-shaft drive you have only one avenue of transmitting your power from your engine to your line shaft, where with electric drive you have, as a rule, duplicate units, and if for any reason one set is put out of service the auxiliary set is always ready to be put into commission.

There is also the advantage in having your generating station composed of several units so that if anything goes wrong with one unit only a portion of your shop may be shut down. Then, too, this is not always necessary, for generating stations will, as a rule, easily carry 25 per cent overload for a couple of hours and thus give sufficient time in some cases to make necessary repairs. It is almost always necessary to run your steam plant at all times for supplying current for lighting and power at some points in close proximity to the shop, and should the occasion arise where some special job has to be taken care of during the time when the shops are not in actual operation, the current is always available for your motor at any point which you might desire. Engine-houses and coaling plants which require power and light can be thus supplied without having a power-house installed at these points.

A few years ago the load factor of railroad machine-shops was about 19 per cent. and due to the introduction of high-speed tool steel and the motor for individual drive the load factor has been raised in some shops to approximately 37 per cent.

With shop equipped with tools for motor drive the whole shop layout can be rearranged from time to time to suit the various conditions which may arise in the method of handling the different work and also the installing of additional new tools, and it is also possible to take advantage of floor space which in the case of a shop with line shafting it would be impossible to utilize.

A very distinct advantage that the shop equipped with motor-operated tools has over the shop operated with line shafts is that the belts and overhead work are done away with. such shops are lighted much more efficiently and a great deal of danger is eliminated.

Discussion.

W. H. Flynn—Our new shop at St. Thomas is electrically equipped throughout. We first tried the group system but found it had disadvantages and all the machinery now purchased has individual drive.

F. F. Gaines—It is surprising the way you can increase the output of woodworking tools with individual drive.

G. M. Crownover—With individual motor drive we find that we are getting 20 to 30 per cent more out of our shop, because we have been able to group our machines more efficiently.

J. F. De Voy: When our woodworking shop at Milwaukee burned a few years ago, we installed individual motor drive on the machines in the new shop and found that the power consumption was but 63 per cent of the consumption with belt drive.

TUESDAY, JUNE 16, 1914.

LOCOMOTIVE HEADLIGHTS.

There being no special instructions, the committee decided to make a complete investigation of the subject in hand, taking into consideration all viewpoints.

In order to thoroughly cover the work, the majority of the type of headlights now on the market were procured and additional headlights were assembled, in order to completely cover the range of light intensity from the minimum oil headlight to the maximum electric arc headlight. The investigation was then carried on to determine the desirable and objectionable features of headlights of different intensities, irrespective of the character and the source of light, arrangement and design of reflector, etc.

As to the amount of work which the committee has done on this subject, it is probably sufficient to state that there was an average of twenty men devoting their entire time to this investigation during the months of July, August, September, October and November of the year 1913. The committee desires to extend their sincere thanks to Messers. Cook, Minick, Fitz, and their able assistants, and others who worked out the details of these tests in such a thorough and efficient manner.

In rating the headlights it was decided to assume as the reference plane the horizontal plane 3 feet above the rail ahead of the locomotive, and to consider the intensity of the rays striking this plane at various points. All laboratory readings were taken normal to the ray in a vertical plane 25 feet of the focal center and perpendicular to the axis of the beam. Readings were taken at angles to correspond to stations in the reference plane 50, 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1,000 feet ahead of the focal center measured along the axis of the beam. Three points were taken for each station —one corresponding to the center of the track and one corresponding to 20 feet each side of the center, the three points being in the same straight line at right angles to the axis of the beam.

These readings can be expressed either as the apparent candle-power of the beam directed at the given point in the reference plane or as the foot-candle illumination on an object at that point, due to an unreflected source of light, at the location of the headlight, which would produce the same intensity of illumination at the given point.

CONCLUSIONS AND RECOMMENDATIONS.

After going over the results of these tests in detail and after thorough discussion, the committee recommends as follows:

1. In order that a headlight shall be of such intensity as not to cause misreading of signals, obscuring of hand signals, fusees, red lanterns and classification lamps by opposing headlights, and be of such intensity as not to temporarily blind the engineman looking into same, a headlight must have an apparent beam candle-power, not greater than 3,000, referred to the center of the reference plane, from 500 to 1,000 feet ahead of the locomotive.

2. In order that the engineman shall have sufficient illumination ahead of the engine to allow him to readily perform his duties while operating in and out of passenger terminals and industrial sidings, while switching in yard, and to readily locate whistle posts, yard limit and crossing signs and such other landmarks en route, a headlight, due to depreciation or to variations in the intensity of the source, must not at any time during service have apparent beam candle-power less than the following; the readings to be made in a vertical plane 25 feet ahead of the focal center and referred to points at the various stations in the reference plane.

READINGS AT CENTER OF REFERENCE PLANE.

Reading point ahead of focal center.	Apparent beam candle-power.
500 feet	Not less than 450 c.-p.
600 feet	Not less than 490 c.-p.
700 feet	Not less than 500 c.-p.
800 feet	Not less than 500 c.-p.
900 feet	Not less than 500 c.-p.
1,000 feet	Not less than 500 c.-p.

AVERAGE SIDE READINGS (AVERAGE OF READINGS TAKEN AT EACH STATION 20 FEET EACH SIDE OF THE CENTER).

Reading points ahead of focal center.	Apparent beam candle-power.
50 feet	Not less than 30 c.-p.
100 feet	Not less than 110 c.-p.

200 feet........................Not less than 225 c.-p.
300 feet........................Not less than 315 c.-p.
400 feet........................Not less than 350 c.p.

The above readings are to be considered independent of the location of the headlight, the source and intensity of light, the design of the reflector, etc.

To design a headlight to meet the above requirements, the height of the headlight above the rail must be decided upon; then with a given kind of light, the design of reflector, the relative arrangement of reflector and source of light, and the intensity must be such that the readings will fall below the designated maximum with sufficient margin above the minimum requirements, that they will not at any time, during the depreciation of the source of light, reflector, etc., fall below the minimum requirements.

RESULTS OF TESTS LEADING TO ABOVE CONCLUSIONS.

To completely cover the present state of the art, laboratory readings were made of practically all types of headlights now on the market, with an additional number of headlights made up of various designs of reflectors with concentrated filament incandescent lamps of various wattages as the source of light, making a total of about thirty headlights and two hundred combinations.

The illumination in foot-candles at the center and sides of the reference plane were plotted, and from these plots, considering only the center values of the headlight 9 feet 7 inches above the rail, a series of headlights was chosen so as to cover in increments, variations from the lowest intensity oil to the highest intensity arc headlights.

From an examination of the data it is evident that there was only one headlight which will meet the 1100-ft, requirement of one state with a sufficient margin to maintain this requirement in service, namely, headlight No. 22, and even this headlight will not meet the requirements of those states that call for 1500 unreflected candlepower. The intensity of this headlight (1,000,000 apparent beam candlepower) is decidedly dangerous to railroad operation, as will be shown later; its only redeeming feature being the illumination of objects with sufficient intensity to render them visible to the engineman at some distance. In view of the fact that 800 feet is about the average distance at which an object can be seen on a clear dark night, this is a very doubtful advantage, as it would be impossible for the engineman to apply the brakes in sufficient time to stop a fast train before hitting the object, even though he should be looking at the exact spot at the distance the object came into range of vision. For example, the speed of the average through train operating at 70 m. p. h. would be reduced to only 57 m. p. h. in 800 ft. by an emergency application of the brakes, and to only 40 m. p. h. in a distance of 1500 ft. The above facts show conclusively that even the highest beam candlepower headlights do not properly illuminate an obstruction on the track at a distance great enough for the engineman to stop his train in time to avoid an accident.

MISREADING OF SIGNALS.

A second set of tests was conducted to ascertain the effect of these headlights upon the reading of semaphore lights, switch and dwarf signals, fuses, red lantern set in the center of the track, red lantern swinging across the track, and classification signals. The tests were conducted both with and without opposing headlights. When

Headlight No.	Type.	Source of Light.	Photographs.	Reference Plates — Description.	Reference Plates — Candlepower.	Average Apparent Beam Candlepower.
3	Oil	1⅛" burner	56			
		150° oil, felt wick	57	23	131	500
1	Oil	100-A burner	48			
		150° oil, cotton wick	49	18	129	1,800
18	Acetylene	¼' Cyco	92			
		Prest-o-lite	93	42	147	1,800
1¾	Oil	100-A burner, safety	52			
		"C" oil, cotton wick	53	21	129*	*2,500
1½	Oil	100-A burner	50			
		150° oil, cotton wick	51	20	129	2,500
15½	Incandescent	25 watts, 24 c-p., 6 volts	84			
		Conc. Filt. Tung. Lamp	85	38	143	10,000
13½	Incandescent	35 watts, 33.6 c-p., 6 volts	76			
		Conc. Filt. Tung. Lamp	77	34	135	30.000
19	Arc	26 amperes, 30 volts	94			
		⅝" carbon and 3/16" copper	95	43	149	60,000
21	Arc	8 amperes, 110 volts	96			
		¾" copper and ½" magnetite	97	44	151	150.000
26	Arc	26 amperes, 30 volts	102			
		⅝" carbon and ½" copper	103	47	151	350,000
22	Arc	25 amperes, 32 volts	98			
		⅝" carbon and ½" copper	99	45	149	1,000,000

The headlights chosen for the further tests were as follows, rated in accordance with the average of the center readings between 500 and 1,000 feet:

(*No. 1¾ headlight was not used in the original laboratory test. It was practically identical with the No. 1½, and the apparent beam candlepower is therefore given as 2500.)

In making the tests for visibility of dummies the lamps were carefully carried to the laboratory immediately after the tests and read for the intensity of the rays illuminating the center of the track.

ABILITY TO SEE OBJECTS AHEAD OF THE TRAIN A SUFFICIENT DISTANCE TO AVOID STRIKING THEM.

The headlights listed above were first tested to ascertain the distance at which dummies could be seen with the dummies standing abreast between rails. Three dummies were used—one dressed in dark blue overalls and jumper, known as the "dark dummy"; one dressed in blue and white striped overalls and jumper, known as the "medium dummy," and one dressed in white overalls and jumper, known as the "light dummy." Visibility curves are plotted for the dark, medium and light dummies for lamps of moderate intensities.

The ability to see dummies with lamps of moderate intensities is fairly well established by the visibility curves, and that there is no apparent difference in the ability to see dummies with a given intensity of light, whether the source is oil, acetylene or incandescent lamps. It will be noted, however, that with arc lamp No. 19, with 60,000 apparent beam candlepower, the dark object could be seen only 557 ft. Calculating from the visibility curve of the dark dummy for oil, acetylene and incandescent lamps, the dark dummy would be seen at the same distance with an apparent beam candlepower of only about 14.000. This effect can be attributed only to the predominance of short violet waves in the arc rays to which the eye does not readily respond.

opposing headlights were used they were of approximately the same intensity.

The classification lamp practically disappeared with an intensity of 40,000 apparent beam candlepower when using opposing headlights, and serious errors in reading semaphore signals were made at and above 90,000 apparent beam candlepower, reaching at 12 per cent error at 330,000. The confusion of yellow and white signals is excluded, as the observers were not accustomed to the yellow signal, and practically all of the errors between yellow and white signals were the reading of yellow signals as white.

Phantoms began to appear with a beam intensity of 30,000 candlepower, this error increasing up to 33 per cent with an apparent beam candlepower of 1,000,000.

There were serious failures in picking up red lanterns swinging across the track, and red lanterns located in the center of the track, running as high as a total of 45 failures with one of the arc headlights out of a total of 98 opportunities, and there were even a few failures to pick up fuses in the center of the track.

It was evident that phantom lights were being obtained with an apparent beam candlepower in the neighborhood of 20,000, and further, that the most serious effect of high intensity of light was the obscuring of danger signals on the track, that is, red lanterns being swung across the track, red lanterns located in the middle of the track, and fuses. In order to fully establish the effect of the opposing headlights, a series of tests was conducted with opposing headlights on the night of October 30, for the picking up of danger signals in the center of the track only. The headlight committee, or their personal representatives, acted as observers, three seconds being allowed to pick up the danger indication, which is considerably more time than enginemen generally have.

The headlights in these tests varied from 2500 to 40,000 apparent beam candlepower. The per cent of errors varied from 0.67 per cent

at 250 apparent beam candlepower to 26.3 per cent at 40,000 apparent beam candlepower. This means, in the case of 26.3 per cent error, that out of 152 opportunities to observe there were 35 failures to pick up danger indications. None of the red indications above mentioned were at a distance greater than 1500 ft. from the observers, and it must be acknowledged that this extremely high per cent of failures is a very alarming and dangerous condition.

In order to check these results with the regular railroad observers, a duplicate set of tests was conducted on the night of November 3, except that in addition to the headlights used by the headlight committee, other tests were conducted with arc headlights, the maximum being 1,000,000 apparent beam candlepower in the opposing headlight. The errors varied from 8.3 per cent at 2500 apparent beam candlepower to 38.9 per cent at 1,000,000 apparent beam candlepower, 39.9 per cent meaning that the regular observers failed to see 49 of the danger indications out of 126 opportunities.

Throughout the tests the percentage of error in reading classification signals was found to increase uniformly with the intensity of the opposing headlight. As it is only necessary for the engineman to determine the classification indication when meeting or passing trains, the potent factor to be considered is the maximum distance at which classification signals can be correctly distinguished.

With the apparent beam candle-power varying from 2500 to 22,000 the classification signals could be correctly determined up to a distance of 1100 ft. with an apparent beam candlepower of 2500, then gradually decreasing to 600 ft. at an apparent beam candlepower of 22,000.

With two trains approaching each other on a double-track road, the classification signals are just about obscured by the front end of the locomotive at 600 ft., so that even with an apparent beam candlepower of 2500 the engineman has only 500 ft. (1100 ft. minus 600 ft.) in the movement of the two trains during which time he can pick up the classification signal. This is ample, but any decrease in the time represented by passing this 500 ft. would be decidedly detrimental to the service.

All the tests indicate clearly that for picking up of danger signals, and the correct reading of classification and semaphore signals, the most desirable condition is the absence of any light on the front of the locomotive.

In the above discussion on misreading signals, we have been dealing with headlights of an intensity insufficient to be of much value in picking up obstructions on the track.

The only four functions remaining for which a headlight is required are as follows:

1. Marker to designate the front end of a train.
2. Warning to the public and employees of the approach of a train.
3. Illumination of numbers on the headlight case.
4. Illumination of the track immediately ahead of the locomotive to allow an engineman to readily perform his duties while operating in and out of terminals, industrial sidings, switching in yard, and to readily pick up whistle posts, crossings and yard limits signs, etc., en route.

After weighing all the results, giving due consideration to the personal equation of the observers, the committee feels that the intensity of light represented by an apparent beam candle power of 3,000 at the center of the reference plane 500 ft. to 1000 ft. ahead of the locomotive, is as high as can be used without incurring undue liability of failure to correctly read signal indications and that this intensity of light will not have, in any noticeable degree, a blinding effect when shining in one's eyes.

The above described maximum headlight has considerable more intensity than is required to amply fill the four requirements stated, and it is recommended by the committee as the highest intensity which can be safely used. The minimum headlight, as given in the second part of the conclusion, is a headlight which the committee feels, from observation, gives an intensity which will amply fulfill the four requirements given above, and the range between minimum and maximum is sufficient.

It will be found that the conclusions of the committee are confirmed by practically all tests of headlights which have been conducted in the past few years.

The Columbus tests, from which the committee has in the main drawn their conclusions, show the dangers to be encountered in the operation of trains with high intensity headlights, or in other words, they show the potential for accidents which exists in the use of high intensity headlights.

It is beyond the ability of the committee to estimate the number of accidents that may be caused by the general use of high intensity headlights. In the past such headlights have been applied principally on single-track railroads. The principal dangers to be encountered are due to opposing headlights and the opportunities for accidents on single-track railroads are very meager in comparison with the opportunities for accidents on lines where two, three, four, five and six tracks are used with automatic block signals, and where a much greater density of traffic obtains.

In this connection, the committee refers to accidents reported by the Interstate Commerce Commission.

[An outline of the method of conducting tests was also given in the committee report.]

METHOD OF CONDUCTING TESTS.

Laboratory Tests—All the headlight cases were mounted on wooden sub-bases of such dimensions that a standard distance was maintained from the front edge of the sub-base to the focal center of the lamp horizontally, and a standard vertical height was maintained from the bottom of the sub-base to the focal center vertically. The sub-bases were all of an equal width and length, and stop blocks were provided on the adjustable platform so that when any headlight was mounted on the platform its focal center was in the same standard location.

To insure constant intensity of the oil and gas headlights during the laboratory test, the center beam was occasionally read with the Bunsen photometer, and it was found that, on account of the short duration of tests of individual headlighs, no adjustment of the wick, cleaning of the reflector, etc., was necessary.

The intensity of the incandescent lamp was kept constant by continuous reading of the voltmeter and ammeter. With the arc lamps it was impossible to keep the intensity of the light constant, on account of the traveling of the arc around the carbons and variations in arc length. An attempt was made to regulate by hand through a resistance, but this was found impossible, due to a lack of close automatic regulation. Continuous readings of the voltmeter and ammeter were taken and it was found that the energy supplied to the arc lamps was within a variation of 4½ per cent above and below normal. A further effort to obtain more consistent results was made by using a storage battery in place of the generator, but no improvement was obtained.

The height adjustments of the headlight platform and the rotary adjustments of the photometer sliding table were calculated to correspond wih the correct angles. The rotary adjustment of the field-glass elbow was determined by the use of a 6-in. sight tube having needle holes in center of diaphragms at each end. For a given location, the sight tube was sighted at the concentrated filament of the incandescent lamp in the headlight, and record made of the position, these records forming the table above mentioned.

Three readings were taken at each point to obtain average results, except in case of arc lamps, when ten readings were taken at each point as rapidly as possible.

The apparent beam candlepower was then calculated, using the exact distance from the focal center of the headlight to the horizontal axis of the field-glass elbow, and this apparent beam candlepower was plotted against the distance for the candlepower curves of the various headlights. At any given point on the reference plane the foot-candle illumination was then calculated from the corresponding apparent beam candlepower, in both cases assuming that the law of inverse squares holds true.

It is further recommended by the committee that future measurements of headlights be made in a laboratory in order to have a common standard laboratory of sufficiently small dimensions that it can be erected at any railroad shop, and a range short enough to give foot-candle readings of sufficient intensity to be well within the range of correct reading.

The committee encountered various difficulties in attempting to take readings in the field, using actual distances, and this method is not recommended on account of the liability of large errors, due to outside lights, atmospheric conditions, etc., and the difficulty of making correct readings on account of the intensity of the illumination being so low that it is difficult to read accurately.

In constructing a laboratory as above described to obtain readings comparable with those taken at Columbus, all dimensions must be absolutely correct and in accordance with the drawings of the Columbus laboratory, elevating platform and photometer trestle.

Field Tests—Tests were made in an open field with a few of the selected headlights to check the laboratory readings. An assumed elevation was taken for the height of the rail, and the location of headlight for the 9 ft. 7 in. height and 12 ft. 7 in. height was made in reference to this assumed elevation.

Dark nights, that is, nights without the moon, were chosen for the field tests, care being taken that there were no outside lights to interfere with the readings, and the readings were taken in the same manner as in the laboratory tests.

In the field tests several of the selected headlights, as described in the early part of this report, were tested. The high intensity of the arc lamps gave foot-candle readings of sufficient intensity to be read accurately, and also of sufficient intensity to minimize the possibility of errors, due to outside general illumination, and it was found that these readings, in view of the extreme variations in the regulation of the arc, etc., checked closely with the laboratory results.

In the test of incandescent lamps the readings were not at all consistent. All of these incandescent lamps had concentrated filaments, and it was found in the visibility tests that it was extremely difficult to maintain the relation between the concentrated filament and the reflector, such as to keep a constant intensity of rays, and in the visibility tests it was necessary after making the tests to take the lamp immediately to the laboratory and calibrate same in order to get the intensity of the rays as used in the tests. It was, therefore, felt

advisable to eliminate the field results of the incandescent lamps, due to the liability of excessive variations in the condition of the lamp itself.

On account of the difficulty encountered in securing close checks between field tests and laboratory tests of the incandescent and oil headlights, it was thought desirable to repeat the field tests under conditions where the interference of atmospheric conditions, etc., would not obtain.

Signal, Lamp, Observation and Obstruction Tests—The tests were conducted in the following manner: The observation locomotive was stationed with the focal center of the headlight at the zero mark, the observers being in their places with the cab door shut. The aspects to be observed, that is, the location of signals, position of the switches, opposing headlights, classification lamps and other obstructions or dummies, were arranged in accordance with a predetermined schedule. When the aspect was set up the man in charge of the observers was notified and he in turn put out a number on the left-hand side of the cab, the first observation of any designated test was known as "Observation No. 1." The operator then turned out the light in the cab and the door was opened. The observers were given all the time they desired to note the observation, and the light was turned on with the door still open, and the observers made a record of what they saw.

The observation locomotive was then moved forward 100 ft. for the next observation, advancing in 100-ft. movements to the 800 or 1,000 ft. mark, depending upon the character of the test. The semaphore signals were 300 ft. and the opposing headlight 500 ft. beyond the 1,000 ft. mark.

Visibility Test—Stationary Dummies—A series of tests was conducted with the selected headlights to determine the distance at which stationary dummies could be seen. These tests were so conducted that no observer could tell the distances at which the other observers saw the dummies, thus entirely eliminating all chance of suggestion. Further, if there had been no dummies on the track, this fact could not have been known by the observers collectively, but only to each individual, as conversation or any indication of observation was strictly prohibited.

Visibility Tests—Zigzag Dummies—It was thought advisable to determine whether stationary and moving dummies of the same size, color and shape could be seen at the same distance. Accordingly, a set of tests was conducted in which the dummies zigzagged across the track. These tests are described as follows:

The observation locomotive was stationed at the zero mark with the door of the observation cab open. A man dressed in white, blue and white striped or blue overalls moved toward the locomotive, starting at a considerable distance beyond the range of vision of the observers, and zigzagging back and forth from one rail to the other. He advanced 8 or 9 ft. while crossing diagonally from one rail to the other. As soon as any observer saw the dummy the fact was indicated by a blast from the locomotive whistle, thus stopping the dummy to make record of the distance and to collect observation sheets. Distances were not relayed back to the observers, but instead were noted in the field, thus the observers were unable to determine whether the dummy was advancing or receding.

SUPPLEMENTARY TESTS—DANGER SIGNALS.

These tests were conducted in the same manner as the "Signal Lamp," "Classification" and "Obstruction Tests," with the exception that the observers were allowed only three seconds to make the observations, that is, when the aspect was ready the light was turned out in the cab and the door was opened for three seconds and then closed, during which interval the observers looked for the danger indications. On closing the door the light was turned on and the observers made record of their observations. All of the above tests were conducted on the Columbus shop track, and were conducted with opposing headlight having intensities equal to the intensity of the corresponding headlight on the observation locomotive. Not more than two danger indications, out of a possible three, were used at any one time, that is, there might have been one or two or none, the observers merely looked for indications which were always located between the rails.

The three danger indications used in these tests were: a red lantern located in the middle of the track, fuses burning in the middle of the track, or a red lantern swung across the track.

RESULTS OF TESTS.

Laboratory Tests—In these tests all the headlights were used in various combinations.

An analysis of the results shows conclusively that there is practically no difference in the illumination on the reference plane with the headlight located at a height of 9 ft. 7 in. as compared with the height of 12 ft. 7 in. above the rail. This would be expected from the fact that there is very little difference in the distance from the focal center to a given point on the reference plane for the two heights, and there is very little difference in the angle of the light from the source, and for this reason all further reference to the results of the tests of headlights at 12 ft. 7 in. above the rail will be eliminated.

The No. 1¼ headlight with 150 deg. oil and 100-A burner shows the same results for the plain reflector with a 5-in. hood and a reflector provided with a Mangin mirror. The candle-power readings are slightly higher for the plain reflector. The results indicate that, as far as the center readings are concerned, they are practically constant at 200 ft. and beyond, the 200 ft. mark corresponding to an angle of 1 deg. 11 min. from the axis of the beam.

In the tests with the incandescent lamps it was found that with the concentrated filament tungsten lamp, the candle-power readings were not consistent with the candle-power of the bare lamp.

In connection with the laboratory tests, candle-power readings were taken of various sources of light, without the aid of a reflector, these readings consisting of the average of a number of readings taken in the horizontal plane.

Visibility Tests—In the preliminary test there was found to be considerable variations in the distances at which dummies could be seen on different nights with the same headlights, although on all occasions it was the endeavor to maintain a constant apparent beam candle-power of the various headlights by the proper adjustment of the sources of energy. In view of the variations found, when the visibility tests were run on the nights of September 24 and 25, each headlight was taken to the laboratory immediately after the test was completed, and a set of readings taken to ascertain the apparent beam candle-power during the test.

The tests are of interest: first, from the point of view that they give distances at which obstructions were located when the observers were not looking particularly for these obstructions; and, secondly, the tests show an interesting feature between low and high intensity lights, in that with the high intensity lights the glare of the opposing headlights prevented the observers from locating the dummies at anywhere near the distances obtained in the visibility tests without opposing headlight, while with the low intensity lights the observers were able to locate the dummies at greater distances than they did in the visibility tests without opposing headlights.

Outdoor Tests Supplementing Field Tests—As stated in the discussion of field tests under the heading of "Method of Conducting Tests," it was decided to make some additional tests under more favorable conditions, and a set of tests was conducted at night in the foundry of the Buckeye Steel Casting Company, at Columbus, Ohio, this foundry being about 1,150 ft. long, 70 ft. wide and 40 ft. high.

The following headlights were tested:

Headlight No. 1⅞, which is the same as headlight No. 1¾, with the exception that the reflector was silver-plated with 1¾ oz. of silver.

Headlight No. 1½-A (without mirror), reflector being newly plated with 1¾ oz. of silver.

Headlight No. 14½-A with lamp No. 72, 6.44 volts, having an apparent beam candle-power of 7,500.

A separate set of field and laboratory tests was conducted with these lamps. The oil headlights were tested in two ways: first, with the axis of the beam parallel with the track; and, second, with the front of the headlight tipped up ⅝ in.

A Sharpe-Millar portable photometer was used in the tests and it was found that readings could not be taken at the 800 and 1,000 ft. stations on account of the low reading given on the photometer scale. In place of the readings at these stations the last reading was made at the 600-ft. point. The lamp was so adjusted in the reflector as to give the narrowest possible beam, that is, it was attempted to secure a beam of parallel rays.

Reducing the foot-candle readings to apparent beam candle-power on the assumption that the law of inverse squares was applicable, gave an average apparent beam candle-power of 44,800 with a maximum variation above this average of 7.15 per cent and 9.59 per cent below. As the personal error of reading a photometer is about 5 per cent, there is a maximum error of about 4½ per cent unaccounted for in the above. This 4½ per cent error may be due to any or all of three causes, as follows:

1. Inaccuracies in setting up the photometer in such manner as to read the same ray at each station.
2. The ammeter used in conjunction with the photometer reference lamp had a very small scale and it was difficult to read current to more than three decimal points.
3. The foot-candle scale on the photometer is such that in reading low candle-powers it is difficult to read to three decimal points.

These three possibilities of error, combined with the fact that in the low foot-candle readings it was necessary to use a screen in order to get any readings, and when considered in conjunction with the field tests noted above, make it appear safe to assume that the law of inverse squares is applicable to headlights of this character.

As to the comparison of the oil headlights, No. 1⅞ and No. 1½-A (without mirror), that is, the headlight equipped with the mirror reflector and the one not equipped with the mirror reflector, the results of tests show conclusively that there is no difference in the character of the light from the two headlights in question, the only difference being that the No. 1⅞ gave an apparent beam candle-power about 20 per cent higher than the No. 1½-A (without mirror).

Committee:—D. F. Crawford (chairman), A. R. Ayers, C. H. Rae, H. T. Bentley, F. A. Torrey, M. K. Barnum, Henry Bartlett.

Discussion.

D. F. Crawford: The people who are so strongly in favor of high power headlights for locomotives are equally strong in their opposition to high power lights on automobiles. The cities of New York and Washington prohibit high power lights on automobiles.

William Alexander: The Chicago, Milwaukee & St. Paul has about 1.600 electric headlights in operation and during a recent six month period in the State of Wisconsin we had 57 train delays due to electric headlight failures. During this period there were but 308 road engines so equipped in Wisconsin.

C. F. Giles: I move that this report be published in a separate volume so that it may be used by railroad representatives before railroad commissions, etc.

This motion was carried.

C. E. Chambers: It would be criminal to operate high power headlights on a four-track railroad having heavy suburban traffic.

C. H. Rae: During the last six years I have appeared before legislative bodies in Ohio, Indiana, Illinois, Tennessee, Kentucky, Alabama, Mississippi, Louisiana and Georgia. Generally we have been successful in defeating high power headlight legislation.

S. G. Thomson: How does the committee's recommendation as to minimum requirements compare with the headlights now in service?

T. R. Cook: With a 1,000-beam candle-power headlight you can see a man in dark clothes 230 feet away, while with a 500 candle-power you can see him about 175 feet away. A 3,000 candle-power headlight will enable you to see a man in dark clothes at a distance of 500 feet.

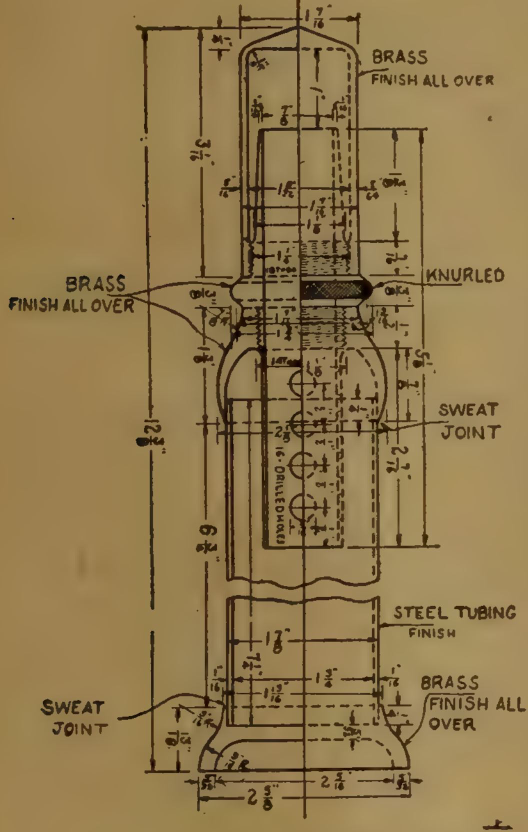


Fig. 1—Engineers' Torch.

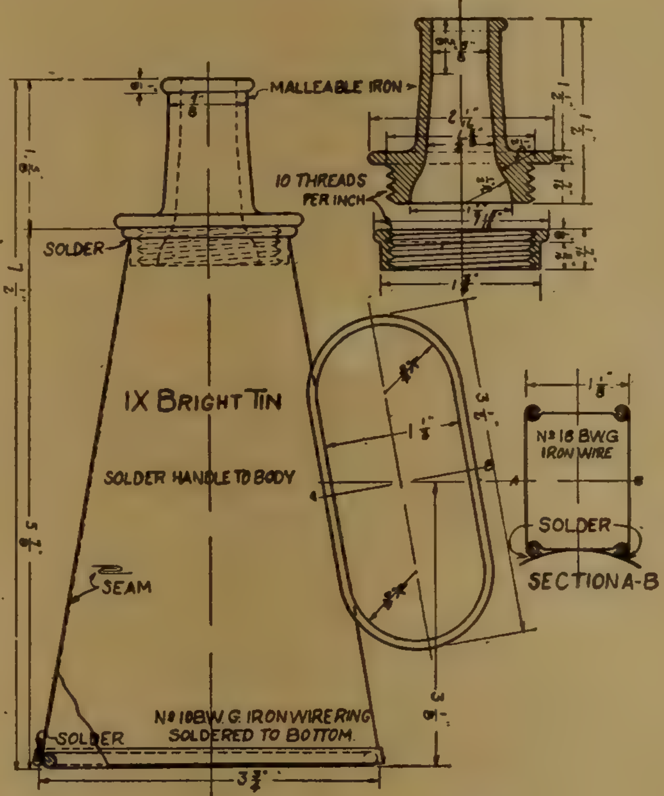


Fig. 2—Torch.

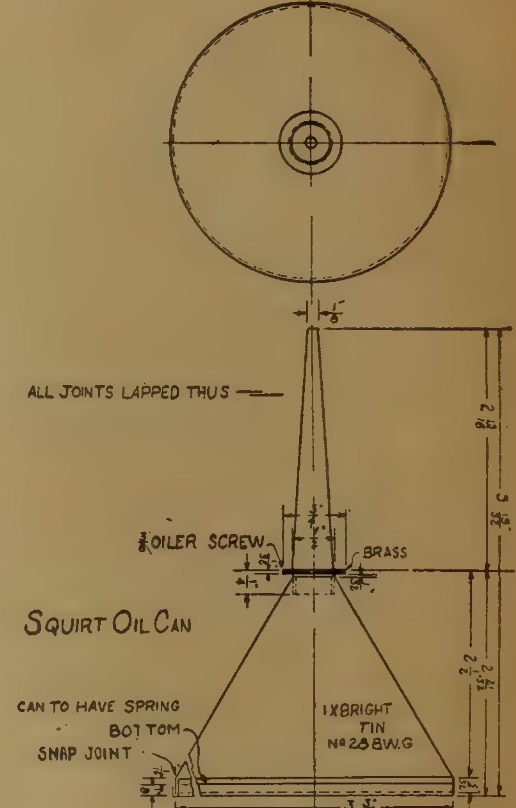


Fig. 3—Squirt Oil Can.

LOCOMOTIVE BOILER CONSTRUCTION.

This committee was unable to present a report because of the press of other business. The subject was continued.

STANDARDIZATION OF TINWARE.

It is the opinion of the committee that it can not hope to present dimensions that will be adopted by each of the railroads. Many of the roads now have their standards; for various reasons they do not wish to depart from same. There are railroad, however, that have not adopted a standard, and while the committee has studied principally the method of construction and the material to be used, they have also selected the dimensions that in their judgment will be most suitable for the service for which each article will be used. This is probably as close as we can ever expect to come to a standard on tinware.

As an illustration, it is well known that a tank bucket has to withstand very severe usage. For this reason your committee is recommending a tank bucket with a bottom of very small diameter, designed with a specially formed wire guard fastening the bottom in place. The bottom of the bucket is also depressed so that it can set over a projection without injury. This form of construction will very successfully withstand the service and the force of a blow to which the tank bucket is subjected.

The committee has endeavored to reduce the number of articles used to a minimum, and finds that a number of roads get along with the articles mentioned in this report. We have not included headlights, cab lamps, lanterns or markers, as we find most roads purchase these articles from manufacturers. Very few railroads have detailed drawings of these articles, or manufacture themselves.

Before reviewing the design and construction of the articles to be manufactured, it might be of interest to review some of the commercial terms applied to the tin used in construction. The plates are referred to as "Coke Tin," "Charcoal Tin" and "Terne Plates."

The base of coke tin plates is the best soft steel, made especially for tin plating. The word "coke" is a trade term, indicating finish. The trade has retained it from the time when high grade tin plates were made from charcoal iron and lower grades from coke iron; hence, plates with lighter coating are called "coke tin plates."

The base metal of charcoal tin plates is especially prepared with a view to securing a high gloss and fine working quality. The trade term "charcoal" is referred to in the description of "coke" finish. It is customary to distinguish the amount of coating and degree of finish by letters "1-A," "2-A," etc., up to and including "5-A." "1-A" grade has the least amount of coating, and each "A" signifies an additional quantity.

One of the leading manufacturers gives the following tabulations for various brands, showing the approximate weight of coating on both sides of the sheet per base box of 112 sheets, 14 by 20 in. For 112 sheets, 20 by 28 in., the weight of coating would be double that shown in the table:

1-A Charcoals	3 lb.
2-A Charcoals	3½ lb.
3-A Charcoals	4 lb.
4-A Charcoals	5 lb.
5-A Charcoals	6 lb.
Premier	7 lb.

They recommend the Premier brand as suitable for all high-class work, such as nickel-plating.

Terne plate, which is generally known as roofing tin, is a product made by coating steel or iron sheets with a mixture consisting of approximately 25 per cent tin and 75 per cent lead. These plates are made from copper bearing open hearth steel. The manufacturers claim that steel of this character amalgamates with the tin and lead mixture in such a manner as to produce a better plate than is possible with ordinary steel, and as a consequence resists corrosion to a remarkable degree. It is also as soft as the best charcoal iron.

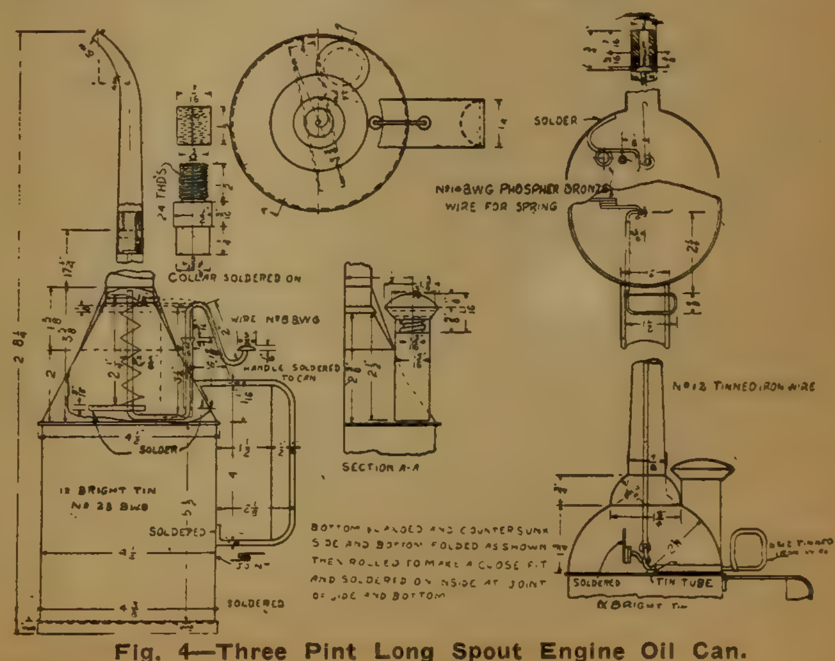


Fig. 4—Three Pint Long Spout Engine Oil Can.

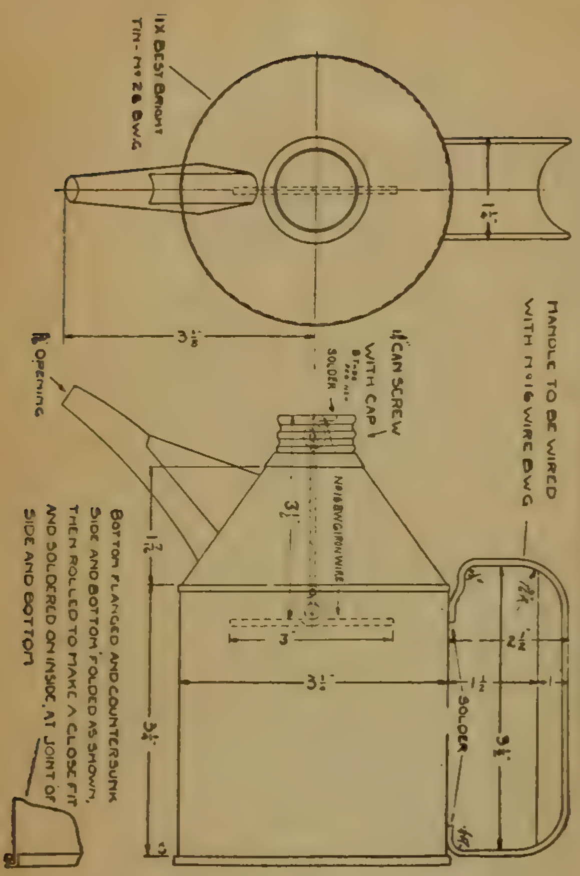


Fig. 5—One Pint Signal Oil Can.

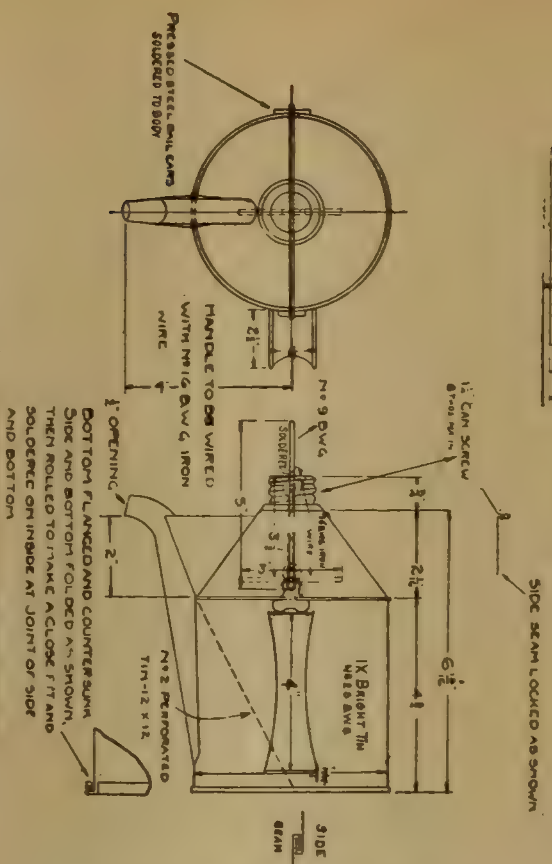


Fig. 6—Three Pint Valve Oil Can.

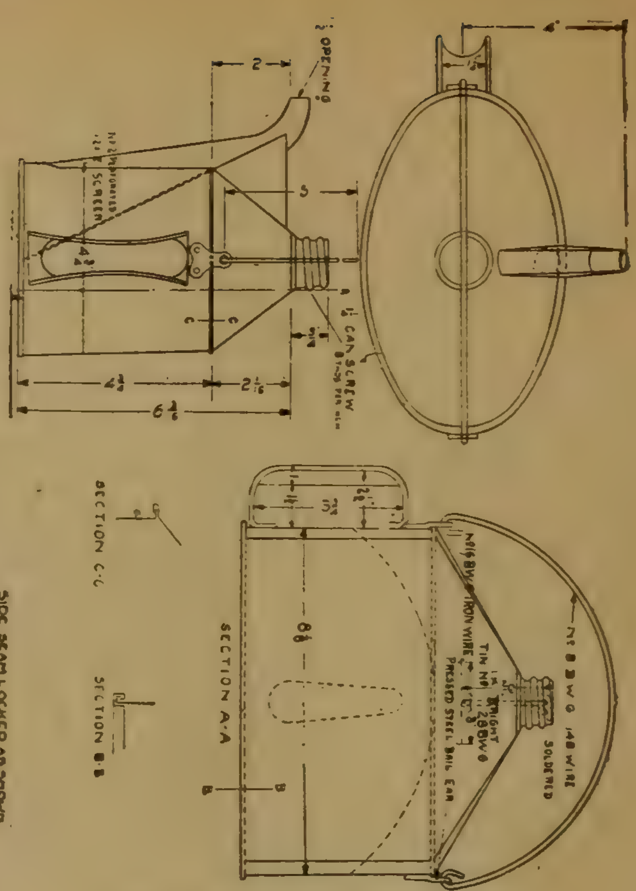


Fig. 7—Five Pint Valve Oil Can.

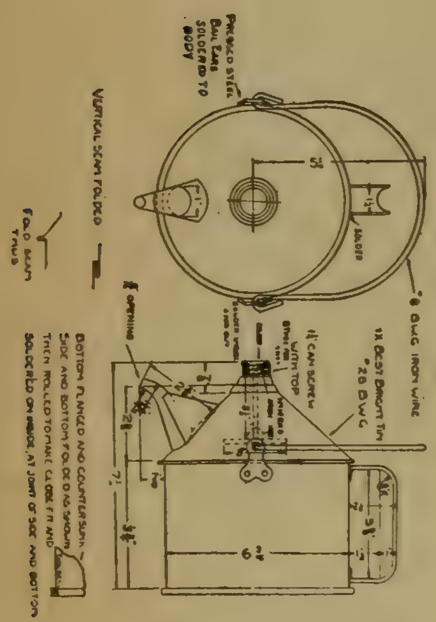


Fig. 8- Two Quart Oil Can.

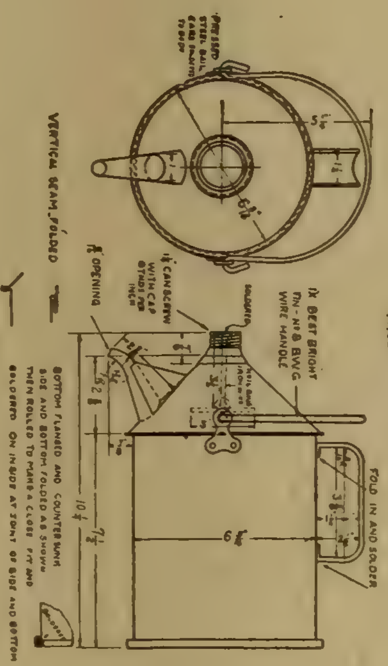


Fig. 9—One Gallon Oil Can.

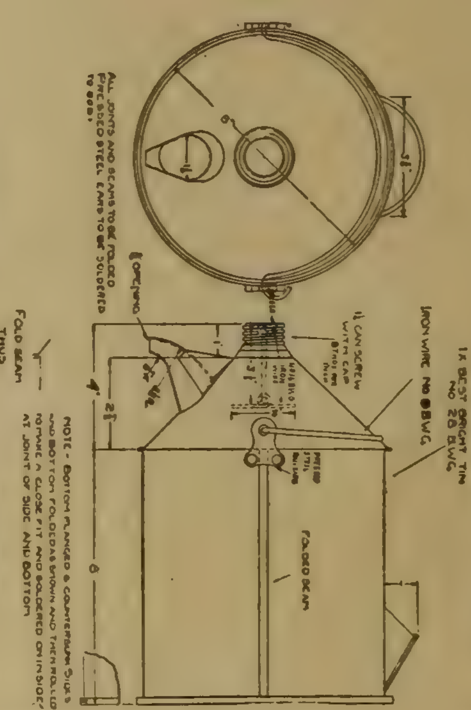


Fig. 10—Two Gallon Oil Can.

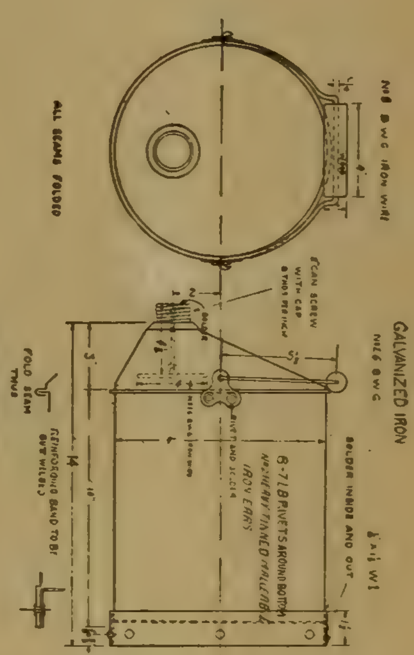


Fig. 11—Three Gallon Oil Can.

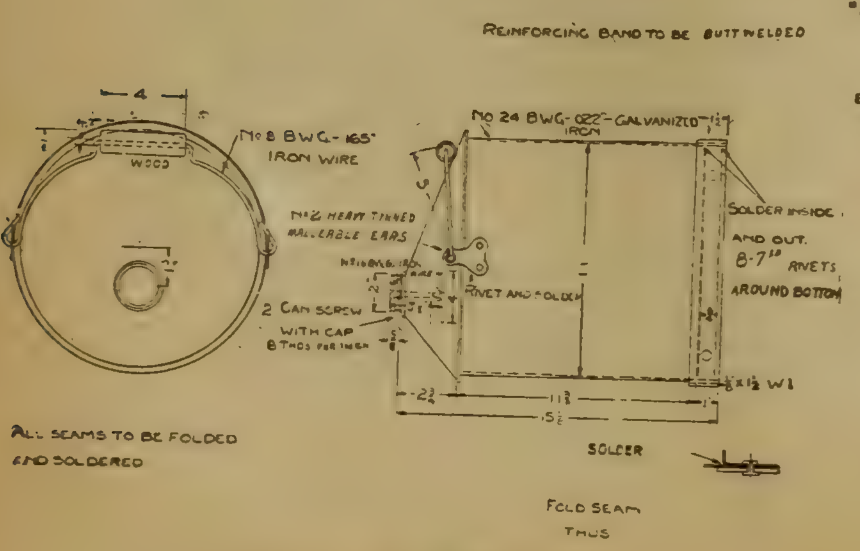


Fig. 12—Five Gallon Oil Can.

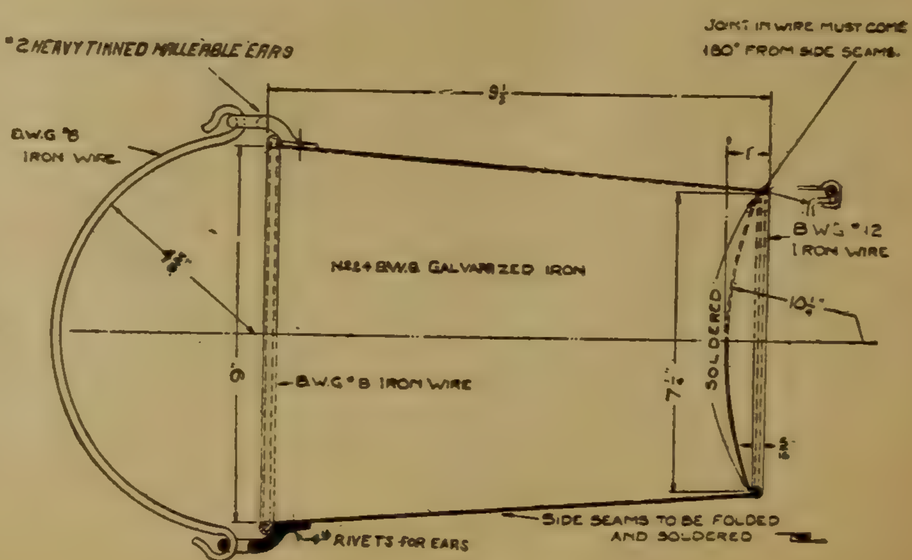
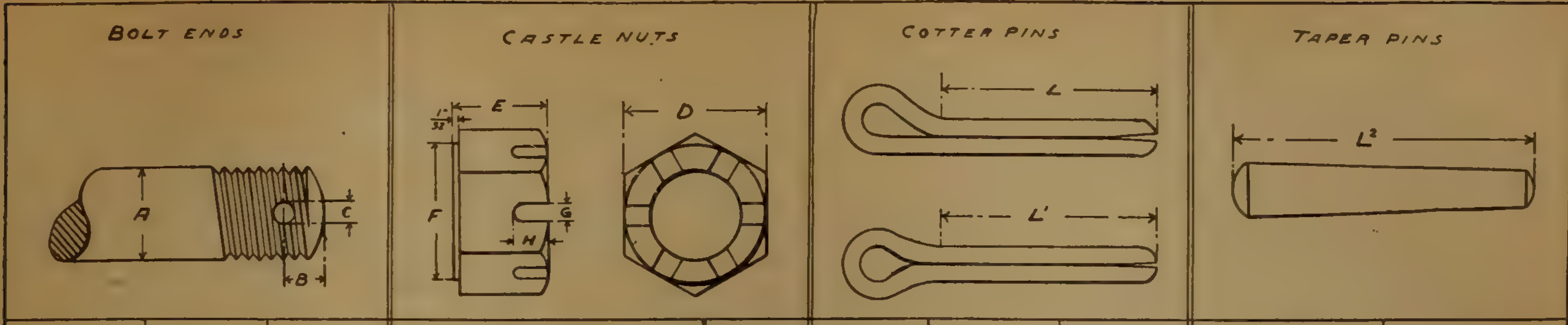


Fig. 13—Two Gallon Tank Bucket.



A	B	C	Standard D	Standard No Thread	Standard E	Standard F	Standard G	Standard H	Thin E	Thin No Thread	Nominal Diameter	L	L'	Number	L²
1/2	3/8	3/16	7/8	13	3/4	15/16	1/4	3/8			3/16	7/8	1 1/2	2	1 1/4
5/8	"	"	1 1/16	11	9/16	1"	"	"			"	1"	1 1/2	"	"
3/4	"	"	1 1/4	10	7/8	1 1/16	"	"			"	1 1/4	1 3/4	"	1 1/2
7/8	7/16	1/4	1 7/16	9	15/16	1 1/4	5/16	3/16			1/4	1 1/2	2"	4	1 3/4
1	"	"	1 5/8	8	1"	1 3/8	"	"			"	"	"	"	2"
1 1/8	1/2	5/16	1 13/16	7	1 1/8	1 3/4	3/8	1/2	1 1/16	8	5/16	1 3/4	2 1/4	6	2 1/4
1 1/4	"	"	2"	7	1 1/4	1 15/16	"	"	1 1/8	"	"	"	2 1/2	"	"
1 3/8	"	"	2 3/16	6	1 3/8	2 1/8	"	"	1 3/16	"	"	2"	"	"	2 1/2
1 1/2	"	"	2 3/8	6	1 1/2	2 5/16	"	"	1 1/4	"	"	"	3"	"	2 3/4
1 5/8	"	"	2 9/16	5 1/2	1 5/8	2 1/2	"	"	1 5/16	"	"	"	"	"	3"
1 3/4	9/16	3/8	2 3/4	5	1 3/4	2 11/16	7/16	9/16	"	"	3/8	2 1/2	3 1/2	"	3 1/4
1 7/8	"	"	2 15/16	5	1 7/8	2 7/8	"	"	1 7/16	"	"	"	"	"	"
2	5/8	"	3 1/8	4 1/2	2"	3 1/16	"	"	1 1/2	"	"	3	"	7	3 1/2
2 1/4	"	"	3 1/2	4 1/2	2 1/4	3 7/16	"	"	1 5/8	"	"	"	4"	"	3 3/4
2 1/2	11/16	1/2	3 7/8	4	2 1/2	3 13/16	9/16	5/8	1 3/4	"	1/2	3 1/2	5	8	4 1/2
2 3/4	[illegible]	"	4 1/4	4	2 3/4	4 3/16	"	"	1 7/8	"	"	"	"	"	"
3"	13/16	"	4 5/8	3 1/2	3	4 9/16	5/8	3/4	2	"	"	4	"	9	5
3 1/4	"	"	5"	3 1/2	3 1/4	4 15/16	"	"	2 1/16	6	"	5	6	"	5 1/4
3 1/2	"	"	5 3/8	3 1/4	3 1/2	5 5/16	"	"	2 1/4	"	"	"	"	"	5 3/4

All dimensions given for finished sizes.
One-sixteenth inch to be added to finished dimensions of nuts for rough sizes.

Standard Castle Nuts and Details.

Practically all of the roofing tin made prior to 1890 was produced by what is known as the "Palm Oil" process, but it is claimed that plates made in the 90's by the acid process are still in use and giving good service. The manufacturers claim plates finished by the acid process are fully as good as those finished by the "Palm Oil" process.

It is important that the mixture covers the iron and adheres to every point; otherwise, there is liable to be what is known to the trade as "Pin Holes," which are injurious and permit corrosion to start. Terne plates, like the other grades, are packed in boxes which show the style of finish, the grade of the plate and the amount of coating.

The process of manufacturing does not produce all perfect sheets, which are designated by the mill as "Prime" plates. A small percentage of the manufactured plates contain pinholes or other defects, and are called "Wasters." When prime plates only are desired, the mill charges a premium for such distinction. This extra cost is waived when the wasters are taken in connection with the primes. Some manufacturers do this by packing the primes and wasters separately, in which event no premium is charged for the primes and a reduction is allowed on the wasters. A second method, the primes and wasters are packed together just as produced and the mills call these unassorted. An allowance is made for taking the wasters in this manner.

CASE OR PACKAGE MARKS.

The cases should show the brand and thickness; erasure of any stencil mark placed on the case by the manufacturer should be promptly noted as requiring careful inspection of contents. Prime plates are known to be in the case by the original condition of the case and by the absence of the waster mark; some manufacturers use a large capital letter "W" to indicate wasters, others use capital letters "US" to designate unassorted.

In the prints submitted we have endeavored to cover every detail, making parts interchangeable where this is practical. It will be noted the joints are double-seamed and the detail of the seam is carefully outlined. The material is specified, standard kettle ears are used, handles are wired for stiffness and the diameter of the wire is in proportion to the capacity of the article, the can tops are interchangeable in groups, and the spouts are carefully braced to withstand rough service. The following is a brief description of each part recommended:

Fig. 1 shows an engineer's torch that is used on one of our railroads. They claim to be getting very good results from same. The special feature of this torch is a cap which screws over the top and prevents oil wasting out into the seat box when the torch is not in use. This feature makes it very popular with the enginemen. Each torch is numbered and recorded. When the torch is given to the engineer it becomes his individual property and is charged out to him the same as any other company property. On account of the special finish of the torch the engineers take a personal pride in retaining them. This road in question has used these torches for several years, and the original torches are still in the possession of the engineers; very few of them are ever lost. While this torch is not tinware, it is used as a substitute for tinware. Its attractiveness makes it an economical proposition because few are used as compared with the ordinary tin torch, and a saving is thereby made.

Fig. 2 shows a very satisfactory form of torch, used on some roads.

Fig. 3 is a squirt oil can made of tin.

Fig. 4 shows two forms of long spout engine oil can in quite general use. It is claimed that the amount of oil saved by the use of these cans will pay for the cost of construction.

Fig. 5 is a one-pint signal oil can. This is furnished on the engine, principally in winter weather, to carry a small amount of oil for emergency use. It is made small and compact to withstand rough usage and to save material.

Fig. 6 is a three-pint valve oil can with an internal strainer made of perforated tin. The opening in the top is made small to require the heating of the valve oil before putting it in the can so that it will readily strain through the perforations.

Fig. 7 shows a five-pint valve oil can, constructed along the same lines, except the elliptical construction. The purpose of this form of construction is to give a large capacity oil can, placing the handle on the side, enabling same to be used in a minimum of space between the lubricator and the roof of the cab.

Fig. 8, two-quart oil can, with double folded seams. Fig. 9, one-gallon can, of similar construction. Both of these cans are made the same diameter, which will permit using the same dies in construction.

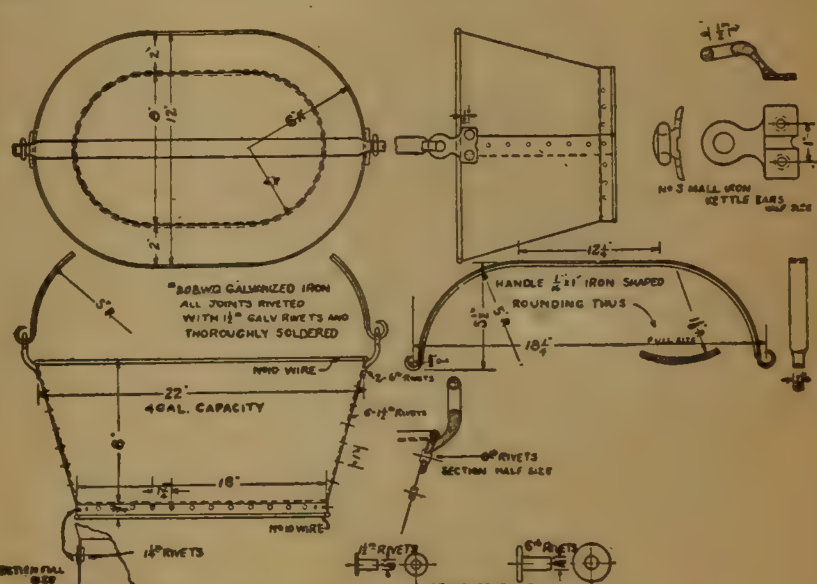


Fig. 14—Sponging Bucket for Engine House Only.

Fig. 10 is a two-gallon oil can, similar in construction to Figs. 8 and 9.

Fig. 11, three-gallon oil can, made of galvanized iron, has the bonnet so constructed as to permit of a free outlet for the oil. The iron band riveted to the flanged edge of the bottom protects the can from rough usage.

Fig. 12, five-gallon, is constructed along similar lines.

Fig. 13 is the two-gallon tank bucket referred to in the first part of this paper.

Fig. 14 is a recommended form of sponge bucket for engine house use. This bucket has a capacity of four gallons or fifty pounds of saturated sponging. It is made elliptical for convenience in carrying, and will hold enough sponging to pack one side of a Pacific type engine, trailer and engine trucks. It is suggested that two buckets be used, one to contain the new sponging and one to receive the old waste removed from the boxes. The size of the buckets is made large to avoid unnecessary trips from the draining vat to the engine being packed.

Committee:—M. D. Franey (chairman), J. C. Mengel, W. C. Hayes, J. A. Carney, S. L. Beau.

Discussion.

M. H. Barnum: I think that we can adopt standards of tinware for both locomotive and general use in the mechanical department and I would not be willing to approve that part of the report. I move that the committee be continued with instructions to bring in recommendations for standards of all classes of tinware.

This motion was carried.

SUPERHEATER LOCOMOTIVES.

In considering subjects it was decided that the question of lubrication had been discussed so lengthily at previous conventions that it was unnecessary to again report on it. The design of front end appliances and the proportion of piston valves were not, in their opinion, practical subjects for investigation without exhaustive experiments, which it was not thought desirable to attempt. They have, however, made an investigation in connection with packing rings, etc., in view of the widely varying results which are reported in engines using superheated steam, and have also the results of the experiments made by the Pennsylvania Railroad on their testing plant at Altoona, on the tests of a class K 2, s a locomotive and on the effect of various changes in the form, length and extent of heating surface of a Schmidt superheater.

The test on a class K 2, s a locomotive has been printed and issued as Bulletin 18, by the Pennsylvania Railroad Company, and the committee recommends that it be reprinted in the proceedings of the A. R. M. M. A., in the same way that the report on the test of a class of E 6 s locomotive was reproduced in the 1913 proceedings.

The test of the K 2, s a locomotive is in many respects supplementary to that of the E 6 s, and in view of the completeness of the record contained in our proceedings of the tests made on superheater locomotives in the United States, we consider that this test should also be reprinted and the Pennsylvania Railroad should be notified of our appreciation of the favor they have extended to this Association.

The tests on a Schmidt fire tube superheater showing the effect of various changes in its form, length and extent of heating surface are presented as part of this report. This test is valuable as indicating the effect of changing the length of the superheating pipes, and the possibility of obtaining results with the return loop shortened which are equal to those with a full length return loop. The tests have been carried out in the thorough manner usual on the Pennsylvania Railroad and this Association is indebted to their general superintendent of motive power, Wallis, for permission to present them.

In connection with packing rings, twenty roads were written operating about 5500 superheater locomotives, and the replies may be summarized as follows:

There is a large variation in the life obtained from piston packing rings, the replies giving from two or three months or 6000 miles, to as high as 50.000 miles or two years.

Roads representing about 25 per cent of the locomotives use a special mixture for piston packing rings, but while most of those who do so report from 50 per cent to 100 per cent longer service from special irons than from ordinary gray iron, the latter is used by those roads reporting the longest life in service. In several cases cylinder iron is used with 1.20 to 1.50 per cent of silicon—the phosphorus also being kept low, not over 0.5 per cent, and with apparently good success. There is, however, considerable variation between different classes of engines, in some cases the life reported in passenger service being double that in freight, while in other cases the reverse occurs. The longest life reported is with the plain ¾-in. square ring which is used by the majority of the roads; but one road using ⅝ by ⅝ in. rings reports a decided improvement as against the ¾-in. wide ring, and exceedingly good results are reported by the Leighton balanced ring which is a special design and used by the Illinois Central.

The great variation in the life is peculiar, as there does not appear to be any explanation of the wide differences reported. The average life for all engines represented is five months, and this figure compares very closely with results reported by several roads that have gone into the matter carefully. It is generally suggested that ample lubrication and the use of the drifting throttle are the requirements for long life, but apart from these suggestions there is nothing to explain the variations.

Replies indicate that there is no trouble with cylinder walls or bushings in superheater engines, other than the wear common to all locomotives.

The majority of the roads have used extended piston rods to some extent with improved results in most cases, especially on large cylinders, 23-in. diameter and over. Replies would indicate that if of proper design this attachment is undoubtedly an advantage, the only question being one of maintenance.

The life of piston valve rings shows a wide variation, from as low as two months to as high as two and even three years. There is no correspondence between the life reported for piston packing rings and valve rings, in many cases roads reporting a long life for piston rings, reporting a short life for valve rings and vice versa. The average life reported is slightly over thirteen months. It is apparently but slightly affected by the material used, but several roads refer to the necessity of boring out the bushings in position to obtain good results. Very little trouble is experienced in the case of piston-valve bushings and there is evidently no serious difficulty in the maintenance of these parts.

Most roads use special types of rod packing, and with a good design there seems to be no difficulty in obtaining a life of 10.000 miles or over, with the 80 lead, 20 antimony mixture. Where this has given trouble on account of severe service and on the high-pressure cylinders of Mallet engines, a mixture of 50 copper, 50 lead has been used to advantage. One road reports improved results on Mallet engines from a mixture of 33 copper, 67 lead, but the 80-20 mixture is the one most used and is evidently satisfactory in the majority of instances.

Committee:—H. H. Vaughan (chairman), R. W. Bell, J. R. Gould, C. H. Hogan, T. Roope, W. J. Tollerton.

The conclusions of the superheater tests are:

1. The standard superheater now in general use is found to give very satisfactory results, with a possibility that some of the return portion could be eliminated with no detriment to the superheat obtained, and with an advantage in cost of material.

2. Too much importance can not be attached to the length of superheater; it must extend as far toward the fire as practical limitations will allow, considering the life of the elements in the hot gases.

3. The single pass is not sufficient to obtain the desired superheat.

4. There is an advantage in the return portion of the superheater, but this part may be shortened without loss of superheat.

5. As the superheat is reduced, the evaporation of the boiler is increased within certain limits, in other words, a boiler without superheater shows a larger maximum evaporation than one with a superheater. The power of the locomotive, however, does not increase with the greater weight of steam produced; on the contrary, the power is reduced with the reduction in superheat.

6. Within the limitations of these tests, the highest superheat does not result in the lowest water rate; this is on account of the fact that to obtain the highest superheat the locomotive may be run at an excessively long cut-off, the long cut-off increasing the water rate to a greater extent than is compensated for by the increase in superheat.

7. It is seen that the advantage of superheating may be utilized in two ways: either in coal and water saved, due to a reduced water rate, or by burning the same amount of coal as would be required in the boiler where it is generating saturated steam and obtaining a decided increase on the power output of the locomotive. If we exclude conditions of starting, this would permit superheater locomotive to haul heavier trains with an attendant saving in transportation facilities and labor.

8. There is another advantage in superheating which only recently is being given consideration, namely, by the application of superheaters small locomotives may be made to haul trains equal to those hauled by saturated steam locomotives of greater weight, and this means that where traffic has outgrown the locomotive and the right of way conditions not permitting the heavier units of power being introduced, trains may be increased in weight by the adoption of superheaters, and thus the time may be deferred when it will be necessary to strengthen up the bridges and general track structure to meet demands for greater economy in the movement of trains.

Discussion.

O. M. Foster: We use about 30 per cent more valve oil on superheaters than we do on saturated engines. We have been troubled with having burned oil in the cylinder and piston valve but have not found out how to eliminate it. We have no trouble with piston rod packing except on slow, heavy freight trains. On some engines we placed an oil cup so that the engineer could pump a small amount of oil on the piston rod when necessary and this device proved very successful. It gives additional lubrication at critical times.

L. R. Pomeroy: Is safe-ending practicable on superheater engines?

W. H. Flynn: We are getting excellent results from safe-ending superheater tubes.

F. C. Pickard: We get, on an average, about 900 miles out of packing rings on high-speed passenger engines.

G. J. Duffy: The main driving boxes give out on superheaters more quickly than they do on simple engines, according to our experence.

SPECIAL ALLOYS AND HEAT-TREATED STEEL IN LOCOMOTIVE CONSTRUCTION.

Engineers and manufacturers have quite generally accepted the term "heat-treatment," as applied to forgings, to cover two principal classes: first, forgings which are annealed, that is, heated slightly above the critical temperature, or point of recalescence, and then allowed to cool slowly; and, second, those which are quenched, that is, heated to a temperature slightly above the critical temperature, then cooled in some medium, and then reheated or tempered.

For sizes commonly used in locomotive construction, the cooling medium is generally oil or water, or a mixture of the two, although various other compositions are sometimes used.

Tempering, or "drawing back," consists of reheating after quenching, to reduce brittleness, and, at the same time, to retain the desired degree of hardness.

Replies to the circular of inquiry were received from thirty-seven railroads and two locomotive builders, covering an ownership of 31,000 locomotives.

There seems to be some doubt as to just what was meant by the term "heat-treated" as used in the circular of inquiry. Where the replies refer to heat-treatment of frames and steel castings, it is probable that they mean annealing only, while in the case of the other parts mentioned, with the possible exception of springs, it may be assumed that the heat-treatment covers quenching and tempering.

Briefly, the replies indicate as follows:

Question 1—Do you use any heat-treated carbon steel in your locomotive construction?

Four roads are using heat-treated carbon steel frames and steel castings.

Two roads are using heat-treated carbon steel for main and parallel rods, nine for piston rods, and twelve for axles and crank pins.

Two roads are using it for tires and wheels, compared with five, one year ago.

One road has discontinued its use altogether, on account of unsatisfactory service obtained.

The use of heat-treated carbon steel is still experimental, and does not appear to have been appreciably extended.

Question 2—Do you use any alloy steels in locomotive construction?

Seventeen roads are using vanadium steel frames, showing an increase of nine over last year.

Ten roads are using chrome-vanadium steel for main and parallel rods, nine for piston rods, four for valve-motion parts, twelve for axles and crank pins, and thirteen for tires and wheels.

Many of those replying as users of alloy steels—in all cases chrome-vanadium—are using it as an experiment, and not as their adopted practice.

Question 3—Give any data you have showing length of service or additional wear obtained from heat-treated carbon steels as compared with plain carbon steels, and alloy steels as compared with plain carbon steels.

Service records and the personal observation of users of chrome-vanadium steel indicate that a considerable increase in wear is obtained as compared with plain carbon steel. The replies do not give any information in this respect concerning heat-treated carbon steel or any other alloys than chrome-vanadium, but it would be reasonable to expect that steel of greater strength than plain carbon steel would wear longer.

Tests show that valve motion parts of case-hardened carbon steel are much harder and wear much better than corresponding parts of quenched and tempered vanadium steel.

Other tests, which, however, are not yet concluded, between carbon steel axles and driving tires, compared with the same parts made of chrome-vanadium steel, indicate that considerable increase in wear may be expected from the vanadium steel.

Question 4—If you have had failures of heat-treated steel, either carbon steel or alloy steel, which were attributed to defects in the original material or to the character of heat-treatment, please describe same, giving as much detail as possible concerning the cause of failure.

The replies to this question indicate that the method of heat-treatment is an active cause of failure of both heat-treated carbon steel and alloy steels; that is, unless the quenching and tempering is properly done there is danger of checking and the production of cracks and unequal stresses.

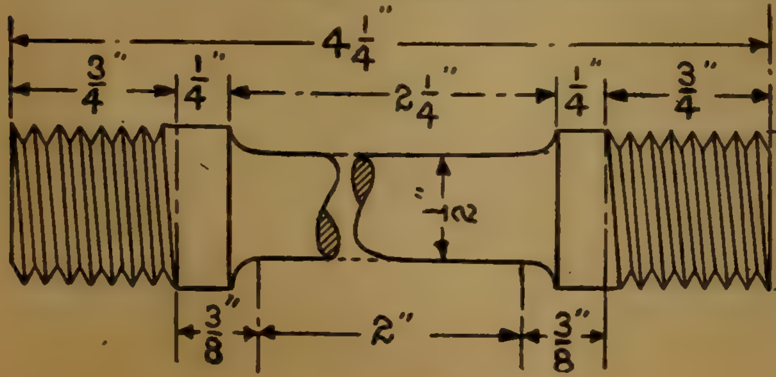


Fig. 1—Tension Test Specimen.

The majority of failures have been attributed to piping, segregation, impurities, and injurious effects of improper quenching.

Question 5—If you are using in your design heat-treated carbon or alloy steels give the unit fiber stress you are allowing for these steels in your design.

In designing locomotive parts, the general practice is to use the same working stresses for heat-treated carbon and alloy steels as for plain carbon steel, it being considered preferable on account of lack of experience with these materials to consider their additional strength simply as a greater insurance against failure.

A few exceptions to this rule have been made which are too recent to indicate to just what extent the increase in strength of quenched and tempered carbon steel and alloy steels may be utilized.

Question 6—If you are using either heat-treated carbon or alloy steels, are you requiring any drilling, such as drilling through the center of an axle, in order to provide for heat-treatment or to detect defective material?

Four roads require drilling of quenched and tempered axles compared with three that reported this requirement last year. Eight roads which did not require drilling last year reported no change in their practice this year, except one, on which drilling is now required. There are altogether six roads that are either drilling, or are contemplating drilling, which did not do this last year.

Question 7—What kind of steel are you using for locomotive and tender springs?

Thirteen roads are using vanadium springs principally for test purposes, but of this number none submitted the chemical requirements of the material. One of these roads reported that vanadium springs did not reduce the number of spring failures in spite of the fact that stronger physical properties were attributed to the steel. The remaining twenty-six roads that replied are using springs of .90 to 1.10 per cent carbon steel.

Vanadium springs are not being purchased under any definite specifications other than the maker's recommendation and the requirements of physical test and inspection.

Carbon steel springs are purchased under specifications which are more or less uniform in their chemical and physical requirements.

Question 8—What fiber stress do you use in designing springs? If you use a different fiber stress for different grades of steel, please give full details.

Vanadium springs have been designed with the fiber stress of 100,000 lb. per square inch, which experience indicates to be a safe value. Carbon steel springs are usually designed with a fiber stress of 80,000 lb. per square inch.

However, the working stresses used in the design of springs appear to be more or less uniform, no allowance generally being made for the kind of steel used.

Question 9—Are you doing any heat-treating at your own shops? If so, please describe the methods employed, the kind of steel, and the character of the parts treated.

But little quenching and tempering of carbon or alloy is being done by the railroads in their own shops, it being their policy to leave this to the manufacturers, with the result that no generally accepted practices have been developed.

Question 10.—In what manner, if any, do you determine whether the heat-treated axle as a whole is satisfactory for service?

Due to the lack of a generally accepted method of proof-testing quenched and tempered axles, certain individual railroads have modified the usual drop test to suit the conditions.

Impact tests of axles are made for the purpose of detecting any flaws which may have developed in the course of the quenching and tempering, such as checks or cracks.

Test pieces for the tension test are also used in some cases, but such tests will not determine the soundness of the axle as a whole, but serve only to determine physical properties of the material from which the axle is made.

Question 11—Are you buying carbon heat-treated material under the specifications for heat-treated carbon steel axles, shafts, and similar objects, which is in force by the American Association for Testing Materials, and if so, does this specification cover your requirements?

The American Society for Testing Materials' specifications, or specifications similar to them, are in use by the majority of users of quenched and tempered carbon steel.

CONCLUSIONS.

There are to be considered in locomotive construction the following four classes of steel for forgings:

1. Unannealed plain carbon steel, of about 75,000 lb. per square inch ultimate tensile strength.
2. Annealed plain carbon steel, of about 80,000 lb. per square inch ultimate tensile strength.
3. Quenched and tempered carbon steel, of about 85,000 lb. per square inch ultimate tensile strength.
4. Alloy steel, of about 100,000 lb. per square inch ultimate tensile strength.

In the case of untreated plain carbon steel and annealed plain car-

bon steel, the elastic limit as determined by the drop of the beam is approximately one-half of the ultimate tensile strength, while in the case of quenched and tempered carbon or alloy steel the elastic limit as determined by the drop of the beam is considerably more than one-half of the ultimate tensile strength.

No decided attempt has been made to utilize the higher physical properties of Classes 3 and 4 (quenched and tempered carbon and alloy steels) due to the lack of sufficient experience in the manufacture of these materials.

Failures attributable to the process of manufacture may be due to

a. Material initially defective,
b. Improper heat-treatment, or,
c. A combination of both.

Defects which may remain latent in untreated or annealed material may be developed even under proper conditions of quenching and tempering to a point where they are harmful. In cases where failures of piston rods, axles and crank pins have occurred, the fracture has usually been transverse, but there have been a few cases of longitudinal fracture.

There are three essentials to the successful quenching and tempering of steel, viz.:

1. The steel should be chemically homogeneous and free from physical defects, and its chemical composition definitely known.
2. Care must be taken that each particular piece is uniformly heated throughout.
3. Quenching should be done under conditions that will secure the uniform cooling of all pieces in each quenching charge. The proper rate of heating and cooling depends upon the size of the piece; small pieces may be rapidly heated or cooled without injury, while large pieces require a relatively slower rate of heating and cooling, to avoid excessive variations in temperature between different parts of the same forging. The medium to be used for cooling depends upon the desired rapidity of cooling. Of the three mediums previously mentioned, water is quickest and oil slowest.

Following up the recommendations of the committee of 1913, the committee submits for consideration two specifications for quenched and tempered steel forgings, one specification covering carbon steel, and the other specification covering alloy steel.

The specification for quenched and tempered carbon steel was drawn up in collaboration with a committee of the American Society for Testing Materials, and is practically the same specification that will be submitted to that society in the latter part of June, slight modifications having been made to adapt it to the requirements of locomotive construction.

The specification covering alloy steel forgings is drawn up to cover the requirements of any alloy steel, the only changes necessary being to insert a chemical composition suitable to the alloy under consideration. The specification, as submitted, covers the chemical composition of chrome-vanadium steel.

The specification for alloy steel includes physical properties which are very similar to those which have been required for about four years by several users of chrome-vanadium steel for locomotive construction, with the exception of the elongation and reduction of area required for axles over 7 inches in diameter.

It has been found that in order to obtain 20 per cent elongation in 2 inches and 50 per cent reduction of area for axles of this size, it is necessary to cool them very rapidly, so that it has seemed advisable to the committee to reduce the requirements to 18 per cent elongation and 45 per cent reduction of area, and insist that such axles shall be quenched in oil, feeling that this treatment will result in less liability of injury to the steel in quenching. This recommendation is made with the approval of several representatives of steelmakers.

Both of these specifications call for drilling forgings over 7 inches in diameter, unless otherwise specified by the purchaser. The committee has found a great tendency among users of quenched and tempered steel to require drilling of parts over 7 inches, and this practice is advocated by steelmakers. In the case of axles and crank pins particularly, drilling takes away practically nothing from the strength of the part; it removes the material from the center where defective material is most likely to exist and where it is least subject to the beneficial effects of heat-treatment, and it allows the forging to adapt itself to expansion and contraction due to heating and cooling.

The specifications leave the proof test optional with the purchaser, but it is suggested that proof tests should be made on all important parts, as this is the best known method up to the present time for detecting internal cracks, which might later cause failure of the part, and which can not be detected by the ordinary tensils or bending tests of small test pieces.

Properly manufactured and treated alloy steels of different kinds have also shown that they are capable of a remarkable amount of bending and distortion without fracture of the material.

It is the belief of the committee that the manufacture of plain carbon and alloy steel to be quenched and tempered will eventually be developed to the point where such material can be used in designs involving much higher unit working stresses than are possible with untreated or annealed plain carbon steel, with a consequent reduction in the weight of parts. In the case of rapidly moving parts, this reduction of weight may a[illegible] expected to result in reduction of wear.

For this reason the committee believes that there is a wide and important field for the use of quenched and tempered carbon steel and alloy steel in locomotive construction, and wishes to emphasize the importance of making continued and extensive service tests with these materials, to encourage and assist in their development.

Committee:—A. R. Ayers (chairman), F. O. Bunnell, F. J. Cole, S. M. Vauclain, J. C. Little, M. F. Cox, C. D. Young.

[The more important specifications only are given in the appendix.]

APPENDIX.

PROPOSED STANDARD SPECIFICATIONS FOR ALLOY STEEL FORGINGS.

(a) These specifications are to cover the various classes of alloy steel forgings now commonly used in locomotive construction.

(b) The purpose for which these classes are frequently used are as follows:

Class A—Forgings for main and side rods, straps, piston rods, crank pins, and all other forgings which are to be machined with milling cutters or complicated forming tools.

Class B—Forgings for driving and trailer axles and other parts not requiring the use of milling cutters or complicated forming tools.

Manufacture—The steel is to be made by the open-hearth process, or by any other process approved by the purchaser.

A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

For test purposes a prolongation shall be left on each forging, unless otherwise specified by the purchaser.

(a) All forgings over 7 inches in diameter shall be bored, unless otherwise specified by the purchaser. The boring shall be done before heating for quenching.

(b) If boring is specified, the diameter of the hole shall be at least 20 per cent of the maximum outside diameter or thickness of the forging, exclusive of collars and flanges.

For quenching and tempering the forgings shall be allowed to become cold after forging. They shall then be uniformly reheated to the proper temperature to refine the grain (the group thus reheated being known as a "quenching charge"), and quenched in some medium under substantially uniform conditions for each quenching charge; forgings under Class B, over 7 inches in diameter or thickness, are to be quenched in oil. Finally they shall be uniformly reheated to the proper temperature for tempering or "drawing back" (the group thus reheated being known as a tempering charge), and allowed to cool uniformly.

Chemical Properties and Tests—The chemical composition of the steel shall be in accordance with the alloy used, and as approved by the purchaser.

For chrome-vanadium steel, the chemical composition shall be as follows:

Carbon, .28 to .42 per cent.
Manganese, .40 to .70 per cent.
Phosphorus, maximum, .05 per cent.
Sulphur, maximum, .05 per cent.
Vanadium, not under .15 per cent.
Chromium, .75 to 1.25 per cent.

An analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt, a copy of which shall be given to the purchaser or his representative. This analysis shall conform to the requirements specified.

Analysis may be made by the purchaser from a forging representing each melt, which shall conform to the requirements specified in Section 7. Drillings for analysis may be taken from the forging or from a full-sized prolongation of the same, at any point midway between the center and surface of solid forgings, and at any point midway between the inner and outer surface of the wall of bored forgings; or turnings may be taken from a test specimen.

In addition to the complete analysis, a phosphorus determination may be made by the purchaser from each broken tension test specimen, and this determination shall conform to the requirements for phosphorus specified in Section 7.

Physical Properties and Tests—(a) The forgings shall conform to the requirements as to tensile properties specified in the table. This is for forgings whose maximum outside diameter or thickness is not over 10 inches when solid.

CLASS A.

	Tensile Strength	Elastic Limit. Min.	Elongation in 2 in., Min.	Reduction of Area, Min.
Main and side Rods, Straps, Piston Rods, Crank Pins........	90,000 to 100,000	65,000	50%	50 in.

CLASS B.

Size.	Tensile Strength	Elastic Limit. Min.	Elongation in 2 in., Min.	Reduction of Area, Min.
Up to 7 in. diameter or thickness when solid, or 3½ in. maximum wall when bored	100,000 to 120,000	75,000	20%	50%

7 in. to 10 in. in diameter or thickness when solid, or 5 in. maximum wall when bored	100,000 to 120,000	75,000	18%	45%

(b) The classification by size of the forgoing shall be determined by the specified diameter or thickness which governs the size of the prolongation from which test speciment is taken.

(c) Elastic limit shall be determined by means of an extensometer.

(d) Test of forgings shall be made only after final treatment.

If specified by the purchaser, bend tests shall be made as follows:

(a) For forgings up to 7 inches in diameter or thickness when solid or 3½-inch maximum wall when bored, the test specimen shall bend cold through 180 degrees on a 1-inch flat mandrel having a rounded edge of ½-inch radius without cracking on the outside of the bent portion.

(b) For forgings 7 inches to 10 inches in diameter or thickness when solid, or 5-inch maximum wall when bored, the test specimen shall bend cold through 180 degrees around a 1½-inch flat mandrel having a rounded edge of ¾-inch radius without cracking on the outside of the bent portion.

Unless otherwise specified by the purchaser, all forgings shall be subjected to an impact proof test. The details of this test shall be agreed upon by the manufacture and the purchaser.

(a) Tension and bent test specimens shall be taken from a full size prolongation of any forging. For forgings with large ends or collars, the prolongation may be of the same cross-section as that of the forging back of the large end or collar. Specimens may be taken from the forging itself with a hollow drill, if approved by the purchaser.

(b) The axis of the specimen shall be located at any point midway between the center and surface of solid forgings, and at any point midway between the inner and outer surfaces of the wall of bored forgings, and shall be parallel to the axis of the forging in the direction in which the metal is most drawn out.

(c) Tension test specimens shall be of the form and dimensions shown in the figure.

(d) Bend test specimens shall be ½-inch square in section with corners rounded to a radius not over 1/16 inch, and need not exceed 6 inches in length.

QUENCHED AND TEMPERED CARBON-STEEL AXLES, SHAFTS AND OTHER FORGINGS FOR LOCOMOTIVES AND CARS.

Chemical Properties and Tests—The steel shall conform to the following requirements as to chemical composition:

Carbon	First-class by size	0.35—0.60 per cent.
	Second-class by size	0.35—0.65 per cent.
Manganese		0.40—0.70 per cent.
Phosphorus		not over 0.05 per cent.
Sulphur		not over 0.05 per cent.

Physical Properties and Tests—(a) The forgings shall conform to the minimum requirements as to tensile properties specified in the table. This is for forgings whose maximum outside diameter or thickness is not over 10 inches when solid.

Engineers' Association, the Air Brake Association, the General Foremen's Association, the Railway Fuel Association and others.

SUBJECTS.

The committee on subjects for the 1915 convention recommends the following subjects for the consideration of the Association.

As compared with previous reports, the number is less, with the belief that some of the subjects now under consideration, but not included in this report, may be continued.

1. Revision of standards.
2. Mechanical stokers.
3. Recommended method for uniform calculation of stresses in boilers.
4. Locomotive counterbalancing, with possible reduction in the weight of reciprocating parts.
5. Maintenance of electric equipment: Locomotives, cars and shop machinery.
6. Tender trucks: Design, and location of side bearings.
7. Alloy steels.
8. Forgings: Specifications for.
9. Plate springs: Design and heat treatment.
10. Boiler washing: Best method of caring for, at terminals.

TOPICAL DISCUSSION.

11. Improvement in piston valves.
12. Cylinder lubrication with graphite.
13. Electric welding of flues.

The reasons which govern the committee in making these recommendations are:

1. Revision of standards.

A naturally continuing subject.

2. Mechanical stokers.

Additional stokers are being continually brought forward.

3. Recommended method for uniform calculation of stresses in boilers.

There is reason to believe that not all roads are calculating the stresses on an identical basis, and consequently the figures for safety factor as reported may not be strictly comparative.

4. Locomotive counterbalancing.

This subject is recommended for further consideration, for the reason that with the increasing static weights on driving wheels, the question of dynamic augment due to counterbalancing is becoming exceedingly important, and the necessity for an improvement in the direction of a reduction of the reciprocating weights which will reduce this augment assumes at the present time an importance which it did not possess in the old days, and the principal consideration was that of securing satisfactory fore and aft balance of the locomotive.

5. Maintenance of electric equipment.

The committee believes that the Master Mechanics' Association should keep closely in touch with the question of electric operation, with the idea that it is impossible to predict where or when electrification of steam roads may be introduced, and if this association ignores the subject, some other association will establish standards.

6. Tender trucks.

Improvements in tender trucks are being made, and no one seems to be satisfied with conditions as they generally exist.

Size.	Tensile Strength, Pounds per Square Inch.	Elastic Limit, Pounds per Square Inch.	Elongation in 2 in., Per Cent. Inv. Ratio.	Elongation in 2 in., Per Cent. Not Under.	Reduction of Area, Per Cent. Inv. Ratio.	Reduction of Area, Per Cent. Not Under.
Up to 7 in. outside diameater or thickness when solid. 3½ in. maximum wall when bored	85,000	50,000	$\frac{2{,}000{,}000}{T.S.}$	20.5	$\frac{3{,}800{,}000}{T.S.}$	39
7 in. to 10 in. outside diameter or thickness when solid, 5 in. maximum wall when bored	85,000	50,000	$\frac{1{,}900{,}000}{T.S.}$	19.5	$\frac{3{,}600{,}000}{T.S.}$	37

(b) The classification by size of the forging shall be determined by the specified diameter or thickness which governs the size of the prolongation front which the test specimen is taken.

(c) The elastic limit shall be determined by means of an extensometer.

(d) Tests of forgings shall be made only after final treatment.

If specified by the purchaser, bend tests shall be made as follows:

(a) For the first class by size, the test specimen shall bend cold through 180 degrees around 1-inch flat mandrel having a rounded edge of 1½-inch radius, without cracking on the outside of the bent portion.

(b) For the second class by size, the test specimen shall bend cold through 180 degrees around a 1½-inch flat mandrel having a rounded edge of ¾-inch radius, without cracking on the outside of the bent portion.

The report was received and the specifications referred to letter ballot.

WORK OF OTHER MECHANICAL ORGANIZATIONS.

A paper covering the work being done by other organizations was presented by Dr. Angus Sinclair, in which he touched on the Traveling

7. Alloy steels.

A continuation of the subject.

8. Forgings specification.

This is a subject for committee work in the American Society for Testing Materials, and the committee believes that the association should keep in touch with the work of its sister societies.

9. Plate springs.

The committee believes that this is still a live subject, both as to design and method of intelligent heat treatment.

10. Boiler washing.

The committee believes that the subject of caring for boilers at terminals has so important a bearing on the question of maintenance as to justify placing it on the subject list.

11. Improvement in piston valves.
12. Cylinder lubrication with graphite.
13. Electric welding of flues.

These three subjects are of increasing importance in view of the general introduction of superheat.

Committee:—A. W. Gibbs (Chairman); C. E. Fuller, C. F. Giles.

This report was referred to the executive committee.

WEDNESDAY, JUNE 17.

SMOKE PREVENTION.

At the convention of 1913 the committee on smoke prevention submitted a report embodying a description and the results of certain tests carried on by the Pennsylvania Railroad at the Altoona testing plant. As a result of these tests, certain conclusions were drawn and recommendations made. At the meeting of the committee for 1913-1914, a set of five questions were drawn up, to be submitted to the mechanical officials of the various railways confronted by the smoke problem, with the intention of bringing out the results of the 1912-1913 recommendations, as well as the results of any further experimentation or application of any other devices than those recommended by the committee. Answers were received from twenty-five roads with a total of nearly 32,000 locomotives.

Following are the five questions asked, with a summary of the answers obtained:

Question No. 1.—Give full progress covering the application and the efficiency of the smoke-preventing air jets, blower, quick-opening blower valve and arch, recommended in your committee's report to the convention of June, 1913.

Of the twenty-five roads, four roads having 4000 locomotives report that they have complete equipment according to Master Mechanics' Association recommendations and are having excellent results.

Seven roads have installed no devices, one of these on account of using fuel oil entirely.

One road reports that it finds no particular value in the quick-opening blower valve as a smoke reducer, but agrees that the other recommendations are smoke reducers.

One road, after extended tests of quick-opening blower valves, finds that the smoke can be eliminated 33 per cent quicker with such valve in use, and as a result of their tests they have decided to adopt quick-opening blower valves. Several other roads agree that its use is effective, especially when unexpected stops are made.

Fifteen roads with about 18,500 locomotives have installed jets and consider that with ordinary handling these are undoubted smoke reducers. Side installations appear to be more in favor than backhead and are also less expensive. One large road considers that with side installations the jets nearest the front of the fire box are most effective.

Two roads with over 1000 locomotives report that arches effect a smoke reduction while working, but produce no noticeable effect while standing.

One road with over 1800 locomotives reports the application of side jets and blower to all its locomotives switching or running into Chicag, and the extension of such application to all switch engines and a large proportion of all road engines on its entire line; the quick-opening blower valve was applied to only a small portion of these engines.

Question No. 2.—Have you installed on locomotives any special devices other than those recommended by the committee?

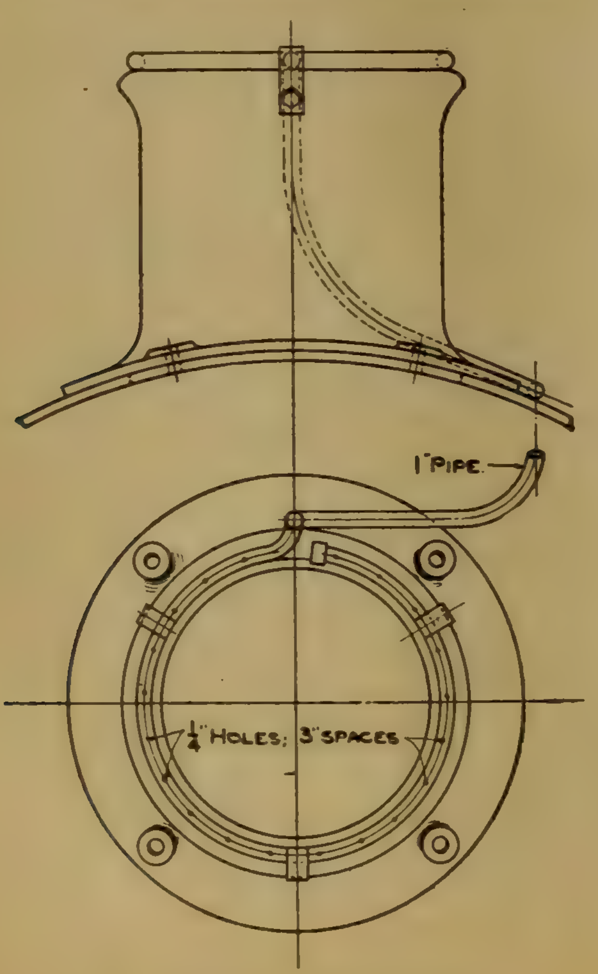


Fig. 1—Smoke Lifting Blower.

Only seven roads, out of the twenty-five, with about 10,000 locomotives, have tried any special devices other than those recommended.

Two of these reports refer to a different style of arch with a combustion chamber; one considers that the mechanical stoker which it is using, when working properly, is an excellent smoke reducer.

Two roads have tried other devices without success.

One road with about 1600 locomotives reports considerable success with the Bates baffle fire door and Heffron draft regulator.

Another large road has attained considerable success by using a ring blower at the top of the stack. Claim is made of almost complete elimination of the smoke on the road and the prevention of smoke trailing into the cab. Cost is about $7.75. The device is shown in Fig. 1.

One road reported the application in the corners of the fire box of special castings from which steam and air are admitted above the fire, and stated that the apparatus was an apparent success, though no figures were submitted. Another road reported trial of this system with less degree of success than with the apparatus according to the committee's recommendations.

Question No. 3.—Have you installed any special device for handling the smoke of roundhouses?

Only one large road has tried any special devices for handling roundhouse smoke. One other large road is about to try a device and still another has the matter under consideration.

The special device referred to is the smoke-washing plant of the Lake Shore & Michigan Southern at the Englewood roundhouse, Chicago, which device has been fully described and illustrated in the various railway journals. (This was described on page 479 of the October, 1912, issue of the *Railway Master Mechanic.*) As this smoke washer was installed in the nature of an experiment, it is impossible as yet to give reliable figures on the cost of such a plant or its operation.

Question No. 4.—What influence on smoke prevention has the superheater on passenger, freight and switching locomotives?

Three large roads having about 4500 locomotives consider that there is no reduction of smoke, due to the superheater alone, all other conditions of operation being the same.

Two roads believe that when engine is properly worked less smoke will be produced with a superheater than without it. This is merely an opinion and not the result of scientific observation.

Five roads believe that there is a reduction in smoke corresponding to the reduction in coal burned by engines equipped with superheaters.

Tests were conducted by the Pennsylvania at the Altoona testing plant, the tests being conducted with both freight and passenger engines equipped with superheaters against the same type of saturated-steam engines. The superheater in freight service effects an undoubted reduction in smoke under the same working conditions. In passenger service, however, the curves indicate that a superheater produces more smoke at the low burning rates, while there is a reduction in smoke at the high burning rates.

The Schmidt superheater appears to be in almost universal use, a few Cole superheaters being the only other ones reported. The fuel economy of the superheater varies from 12 per cent to 35 per cent. One important road reports a saving of as high as 40 per cent in the average number of pounds of coal used per car handled in switching service.

Question No. 5.—Have you investigated various methods of firing-up locomotives in roundhouses, with the special object of preventing smoke?

Only seven roads out of the twenty-five gave definite answers to this question. One road reports smoke reduction by the use of a ring blower hung inside the stack in a horizontal position.

Another road claims to have reduced smoke about 30 per cent by leaving the jets on when firing-up. No costs are given, however.

Three large roads have tried different methods of firing-up, with the following results:

In a test with fuel oil and shavings, atomized fuel oil, oil and engine wood, the last named produced the least smoke and was cheapest, the cost being about $1 per engine. In a test with briquettes, cost about $1.50; soft coal, $2.09; coke, $4.26, briquettes gave as little smoke as coke, and yet, as may be seen, are the cheapest of the fuels tried. Another road finds that by putting coal on the grates and wood on top that less smoke is produced, but cost figures were not given, and it is believed that this method is more injurious to the grates, especially with coal that clinkers badly. Another large road, after considerable investigation, has adopted firing-up with scrap waste, crude oil, wood and coal in the following quantities: Waste, 1 lb.; crude oil, ½ pt.; old car siding, ½ cord; coal, 300 lb.

The method employed is to saturate the waste with the crude oil and throw it in on the grate, after being ignited. On top of this, in small bunches, is thrown the wood. When the wood gets to burning in good shape, six to eight scoops of coal are added; then in about thirty minutes more coal is added.

From the numerous reports above outlined, the committee finds that the application of the apparatus recommended by them last year has proven successful in extended practice toward the elimination of smoke in steam locomotives and suggests its more general adoption.

Committee:—E. W. Pratt, (Chairman); J. F. DeVoy, W. C. Hayes, T. R. Cook, Jos. Chidley, A. G. Kantmann, W. J. Tollerton.

The committee was continued to make further investigations.

METHOD OF CONDUCTING LABORATORY AND ROAD TESTS.

The committee, in accordance with instructions given to it, prepared a code for the testing of locomotives, both upon the road and in the laboratory, and submits a report, which includes not only the method of conducting the tests, but the manner in which the results should be tabulated and proper formulæ for computing all of the items required for the complete test.

Committee:—C. D. Young, (Chairman); W. H. Flynn, Prof. L. E. Endsley, Prof. E. C. Schmidt, J. A. Pilcher.

LABORATORY TESTS.

The object of a laboratory test is to determine the steam and coal consumption per unit of power when the locomotive is operated under fixed conditions.

All driving wheels should be turned to same diameter and should be standard contour.

Each pair of driving wheels should be checked to see that they are correctly quartered for the crank pins.

If the locomotive selected has ever been through the shops for general repairs, the frames should be tried to see that they line with the cylinders.

The boiler tubes must be new or newly pieced, so as to be free from boiler sediment.

The steam cylinders should be approximately the same diameter and as near to that called for as standard for the class of locomotive, as practicable, and they should be bored if not in good condition. The piston packing rings should be in good condition.

On "D" valve type of locomotive the valves and seats should be faced, and on piston valve type old bushings should be bored if not in good condition, or new bushings applied.

Piston-valve packing rings should be examined and in good condition, after which a test pressure of at least 60 pounds should be applied to the steam pipes to determine that the throttle, steam pipes and exhaust passage are tight.

The front end arrangement for the locomotive should be carefully gone over and checked with the print in accordance with which the front end is supposed to have been applied.

The stack and draft pipe should be lined to determine that it is properly erected with reference to the exhaust nozzle.

Steam joints in the injector and delivery pipes should be tested to determine that they are steam tight.

The lift of the throttle valve should be determined for each live notch on the throttle-lever quadrant. When necessary, the cut-off should be taken for each notch on the reverse-lever rack.

The locomotive selected should reach the locomotive testing laboratory at least four days prior to the time when it is scheduled to go under test, in order to permit the application of all instruments and to take the necessary measurements of various parts of the locomotive.

For efficiency tests of locomotives, a standard coal should be selected that can be easily obtained on short notice, and in accordance with the special object in view. If maximum efficiency or capacity is desired, the coal should preferably be some kind that is regarded as a standard for the locality where the locomotive is operated.

When oil fuel is used, the rule governing the tests may be modified to conform to the characteristics of liquid fuel.

The pressure gages for boiler, branch pipe and exhaust should be connected with a long siphon and located at convenient points for the observers. Care should be taken to make correction for pressure should the gage be located so that the water head would affect the reading.

For taking temperature of steam in branch pipe and exhaust passage, thermometers should be inserted into wells, and given proper depth of immersion.

The indicator reducing motion should be some form of pendulum type with light tube for transmitting the reduced motion to a point near the indicator. The pipes leading from the cylinder to the indicator should be not less than ½ inch inside diameter, and they should connect into the side of the cylinder rather than into the heads, thus making a very short connection. Short bends in the pipes should be avoided and they should be well lagged to prevent radiation.

A light framework should be secured to the cylinder to act as a brace for the indicators, and for the motion-rod supports. Absolute rigidity is highly essential in this particular.

Care should also be taken to set the indicators in such position that the finger on the end of the motion rod travels in a direction pointing to the groove in the drum proper.

Draft gages consisting of "U" tubes properly graduated in inches, containing water, should be placed at convenient locations, and connected at the smoke box or any other point at which the draft is taken with a ¼-inch pipe. A rubber tube connection should be provided to connect the draft pipe with the "U" tube. In the smoke box the pipes should be located at the horizontal center line of the boiler in front and back of diaphragm, with the end drilled at the vertical center line of the boiler.

The draft in the fire box should be taken through a drilled stay bolt, located at a point about half the length of the fire box and about 24 inches above the grates. The draft in the ash pan should be taken at some convenient point at about the center of the entire grate area.

The smoke box pyrometer or thermometer should be inserted so that the hot point or bulb is below the tip of the exhaust nozzle and in front of the table plate. If a thermometer is used for this purpose, it should be graduated to 1,000 degrees.

The tube placed in the fire box for inserting the pyrometer should be located opposite the stay bolt drilled for the draft. This tube should be a piece of two-inch boiler tube and located on the center line of a stay bolt.

The gas sampling pipe should be located at the smallest area under the draft plate, and in the center of this area. This pipe should have numerous drilled holes equally spaced and the total area of the holes should not be more than the inside area of the sampling pipe.

A steam calorimeter should be attached either at the dome at a point close to the throttle valve, or to the branch pipe according as it is desired to obtain the character of the steam at one point or the other. The former location is preferred. A perforated ½-inch pipe should be used for sampling and conveying the steam to the calorimeter.

In a laboratory test where maximum efficiency is the object in view, there should be uniformity in such matters as steam pressure, quantity of coal supplied at each firing, thickness of fire and in other firing operations.

The rate of supplying the feed-water should be uniform through the entire test, and a certain level (about second gage cock), should be maintained from start to finish of test.

The duration of a laboratory test of a locomotive will depend upon the character of the fuel used, rate of combustion and working limitations of the revolving parts. The test should preferably be continued until at least 25 pounds equivalent evaporation of water per square foot of heating surface has been obtained. If from the graphical log the coal and water performance are uniform, tests of three hours will be the limit.

The fire having been thoroughly cleaned and banked when necessary to permit coking, previous to starting the test, the bank should be broken up and fresh fuel supplied. The locomotive should be started and run at the speed of the test a sufficient length of time to build up a level fire, and which should be, as near as possible, so maintained throughout the test. When all conditions of fire and speed have become uniform, the thickness of the fire should be noted, but the starting signal for the beginning of the test proper should not be given until the locomotive has been run at least 10 minutes. Observe the steam pressure and time and record the latter as the starting time of test. Water level should be maintained uniformly throughout the test. The ash pan should be cleaned at the starting signal. When the end of the test approaches, the fire having been kept at a uniform thickness during the run, the time and water level should be noted and test stopped. When the test is completed the ash pan should be cleaned and cinders, if any, should be removed from the smoke box.

A log of the data should be entered on printed forms and records taken at 10-minute intervals, unless a special test is in progress, where the readings may be taken more frequently. The coal should be weighed out in not less than 300-pound lots and the time taken for each lot burned.

Weighing tanks of sufficient capacity should be provided to maintain water in the supply, varying in head not more than six inches, and readings of the water consumed should be plotted upon the graphical logs at convenient regular intervals.

Indicator diagrams should be taken at the same periods the other data are taken.

A sufficient number of observers should be supplied in order that all important observations should be taken simultaneously.

All observers, operators, oilers and firemen should assist in dismantling and fitting up laboratory when locomotives are changed.

Ash and all the refuse withdrawn from the ash pan and smoke box at the end of the test should be weighed in a dry state, and if desired, sample taken for analysis of heating value and unburned carbon.

If the coal to be tried is more than the amount necessary to make the test, it should be sampled according to the recommendations of the committee of the American Chemical Society governing carload sampling, which are as follows: Six shovelfuls should be taken along each side and six across the center of the car. If the car is to be unloaded into bins, a small amount of coal should be taken off the conveyor buckets or wagons while the entire car is being unloaded. In all events the sample should not be less than 300 pounds, and after it is crushed and quartered about one quart should be taken and placed in an air-tight jar for chemical analysis. On all tests total moisture should be used in the calculations.

CALORIFIC TESTS OF COAL.

The analyses commonly made are what are termed "proximate" analyses; these consist in the determination of the following items: Fixed carbon, volatile matter, moisture hydroscopic, moisture total, ash, sulphur separately, B. t. u. per pound of fuel.

For complete determinations of the quality of coal, it is necessary to make ultimate analysis, which requires the determination of the

following additional items: Carbon, hydrogen, nitrogen, oxygen by difference.

The data and results should be reported on forms in accordance with items given. [These are not published due to lack of space.]

ROAD TESTS.

The object of a road test is to determine the steam and coal consumption of a locomotive per unit of power under practical conditions of the locomotive in railroad service.

All of the preparations as given in laboratory tests should be carried out preparatory to placing the locomotive in service, with the possible exception of not having all driving wheels newly turned, and equipping the locomotive with the various instruments that can be done while the locomotive is in the shops for repairs.

The same consideration should be given to the fuel as on a laboratory test.

To facilitate the measurement of coal and the determination of the quantity used during any desired period of the run, it is desirable to provide sufficient number of sacks, of a size holding 100 pounds, and to weigh the coal into these sacks preparatory to starting on the test.

All of the instruments given under laboratory test should be carried on road tests as far as practicable, with a few exceptions.

The indicator rig should be some form of pendulum motion with a light tube for transmitting the reduced motion to a point near the indicator.

The apparatus which is most suitable consists of a three-way cock for the attachment of the indicator, with a steam-chest connection, so that diagrams can be drawn on each cylinder card and pressure determined.

The three-way cock should be provided with a clamp rigidly secured to the cylinder and thus overcome any tendency of the indicator to move longitudinally with reference to the driving rig. The support for the motion rod should be secured to some point on the steam chest. Care should be taken to set the indicators in such a position that the finger on the end of the motion rod travels in a direction pointing to a groove in the drum proper.

The pipes leading from the cock to the cylinder should be not less than ½ inch inside diameter, and if possible not exceeding 36 inches in length. They should be connected into the side of the cylinder, rather than into the heads. Sharp bends in the pipe should be avoided and they should be well lagged to reduce radiation.

If a dynamometer car is not used, stroke counter should be placed at some convenient point in the pilot box to record the revolutions of the drivers. This can be conveniently driven from a finger on the motion rod of the indicator rigging.

To facilitate the working of the men who operate the indicators and read the instruments at the front of the locomotive, and to protect them from wind or rain and jolting, a suitable pilot box extending back to the cylinder and properly secured to the bumper beam should be provided.

Whenever practicable, the bulb of the thermometers used in branch pipe, receiver or exhaust should come in direct contact with the steam and no wells used. When thermometers are placed in wells, they do not respond quickly with the different changes in the working of the locomotive.

The water meters should be attached to the suction pipes of the injectors, and located at points where they can be conveniently read while the locomotive is in motion. Each meter should be provided with a check valve to prevent hot water from flowing through them from the injectors, and strainers to intercept foreign material. With the water scoops it will be impossible to use a float, but when tests are made on roads not using water scoops, a suitable float should be made for determining the water consumption. The water level may be established by using a rubber hose with glass tube inserted in the end, which will indicate the height of water in the tank, this tube to be brought in contact with a properly calibrated scale, or, if more convenient, long glass tubes may be provided at each corner of the tank for the same purpose.

In all cases the term "branch pipe" refers to the steam-supply pipe to the cylinders and not the injector branch pipe.

The same operating conditions should be maintained as far as practicable as on a laboratory test.

The duration of a test is the running time minus time the throttle is closed, and depends upon the length of the run between locomotive terminals. In fast passenger service the runs should be, if practicable, at least 100 miles long. In service requiring frequent stops and in freight service, the distance may be much shorter. The length of time upon which the hourly rate of consumption and evaporation are based is the total time that the throttle valve is open and not elapsed time between the starting and stopping time.

The fire having been thoroughly cleaned, banked to permit coking, fresh fuel should be supplied to a level thickness which will be required for the run. After the locomotive is attached to the train, observe the pressure, the water level or meter readings, and when the locomotive starts take this as the starting time. Thereafter cover the fire with weighed coal and proceed with the regular work of the test. The ashes and refuse should be removed from the ash pan and smoke box before the locomotive is coupled to the train.

During the run the fire should be maintained in as equal and uniform condition as practicable, and when the end of the route is reached the fire should be as level and approximately the same thickness and condition as at the start. When the locomotive is stopped and the proper level of the fire obtained, the weighed coal should be discontinued. If during the run a stop of over seven minutes is made, and in order to keep the fire in proper condition fresh fuel must be supplied, this should be selected from the unweighed coal. There should preferably be no water supplied to the boiler, and if it is supplied, allowance should be made for same.

On reaching the terminal, the fire being in the same condition as at the start, the water level and water supply should be noted. The time the locomotive comes to rest should be the time of stop of test.

The tests should be in charge of a competent person who is thoroughly familiar with road operations.

The number of observers required for a test depends upon the nature of the data to be obtained. When making an efficiency test at least six observers should be located on the locomotive, two for taking indicator diagrams and any other data that can be taken from the pilot box, two for cab data and two for coal and water records. It is frequently necessary to increase this force when taking special data.

In the dynamometer car at least four observers are required, one to record the time of each start and stop, passing each station and recording mile posts, point of curvature and tangent and any other important information; one to record all information on the diagram and keep track of indicator cards, and one to take car numbers and weights of trains; this latter man can also act as a relief observer. When making test of Mallet type of locomotive, the locomotive force is increased to take indicator cards from the low-pressure cylinders.

The time to take records depends entirely upon what facilities are available for recording same. If a dynamometer car is available for the tests, records should only be taken when some change in the operation of the locomotive takes place, such as throttle lever, reverse lever and boiler pressure. If the dynamometer car is not available, all records should be taken preferably every five minutes.

Special reading of the meters and total number of sacks of coal fired should be taken at specified stopping and passing points.

Careful observations should be made throughout the run, of the time passing all important points, arriving and leaving each station, and the time that the throttle valve is opened or closed, not only at each stop, but when drifting.

In weighing and sampling the ash and refuse, the same preparation as described for laboratory tests should be followed as far as practicable.

The coal should be sampled while it is being weighed off in 100-pound lots, and a small proportion taken at different times until about 300 pounds is obtained. This should be crushed and quartered and about one quart placed in an air-tight jar and sent to chemist for analysis. When this method of sampling is used, care should be taken that the coal does not take on additional moisture, due to leaky cistern or sprinkler. If there is any question as to the coal taking additional moisture after it is once weighed out, sample should be taken from each sack as they are emptied.

On all tests the total moisture should be used in all calculations.

The same practice as used on laboratory tests for clorific tests of coal should be used on road tests.

The report was received and submitted to letter ballot.

REVISION OF TRAIN BRAKE AND SIGNAL INSTRUCTIONS.

That portion of the Master Car Builders' and American Railway Master Mechanics' Association air brake and train air signal instructions under the heading "General Instructions" has been revised by the committee, and the revision is incorporated in this report.

That portion comprising the "General Questions and Answers" has not been dealt with for the reason that the number of different types of brake equipments now in use is so large, and the fact that local conditions of different roads require special modifications in methods of handling brakes so that it would be practically impossible to formulate a series of questions and answers that would be universally applicable. Moreover, the Air Brake Association has a committee on questions and answers that supplies all the air brake information required in question and answer form, and the committee refers to the comprehensive list of questions and answers published by that association. The committee recommends, however, that a committee from this Association be appointed to confer in conjunction with a similar committee from the Master Car Builders' Association, and the Air Brake Association "Questions and Answers" committee, to the end that the questions and answers shall be kept constantly up to date.

The following comprises the general air brake and train air signal instructions in revised form:

"A"—GENERAL INSTRUCTIONS.

The following rules and instructions are issued for the government of all employees of this railroad whose duties bring them in contact with the maintenance and operation of the air brake and train air signal apparatus. They must be obeyed in all respects, as employees will be held strictly responsible for the observance of same.

Every employee whose duties are connected in any way with the maintenance and operation of the air brake will be examined from time to time as to his qualifications for such duties by the Inspector

of Air Brakes or other person appointed by the proper authority, and a record will be kept of such examination.

Any employee whose work indicates an apparent lack of the requisite brake knowledge will be required to pass an examination at any time following such indications.

"B"—INSTRUCTIONS TO ENGINEMEN.

2. Enginemen when taking charge of locomotives must see that the air brake and train air signal apparatus on engine and tender is in good working order and that the air compressor and lubricator work properly; that the devices used for regulating all pressures are adjusted at the authorized amount; that brake valves work properly in all positions; and that, when brakes are fully applied, with cam type of driver brake, the pistons do not travel less than 2 in., nor more than 3½ in., and with other forms of driver brakes from 4 to 6 in.; that the engine truck and trailer brake piston travel be not less than 4, nor more than 6 in.; that the tender brake piston does not travel less than 6 nor more than 8 in.

Enginemen must report to roundhouse foremen, in writing, at the end of the run, any defects in the air brake or train air signal apparatus.

3. Making Up Trains. Testing Brakes at Terminal Points and Before Starting Down Such Grades as May Be Designated by Special Instructions.—The brake pipe on the engine and under the tender must always be blown out and maximum pressure obtained in main reservoir before coupling engine to train.

After the train has been coupled, stretched and fully charged, the engineman shall, at the request of the inspector or trainmen, apply the brakes with full service application and hold them so applied until all brakes operated from the engine have been inspected and the signal given to release. The engineman must then release the brakes and he must not leave the station until it has been ascertained that all brakes are released and he has been so informed by the inspector, or the trainmen, of the number of brakes in service and of their condition. If any defect is discovered during this test same must be corrected and brakes again tested, and the operation repeated until the brakes are known to be in good condition.

In testing passenger train brakes, signal for releasing must be given from the air signal discharge valve on rear car.

Following the separation of couplings for local switching, or when engine is parted from train, or train has been parted for any purpose, the above test need not be complied with further than to ascertain, by test, that the rear brakes are responsible to brake valve on engine and that all brakes have properly released. However, when cars are added to train, the brakes on such cars must be inspected as in terminal test. When a back-up hose is to be used to control the train, the brakes must be applied for test with the back-up hose, and released from the brake valve on the engine.

4. Service Application—Passenger Trains.—In making service stops from high speed, two applications should be used. The first application should be derived from two or more brake-pipe reductions, and when the speed has reduced to about 15 miles per hour, release all brakes, and complete the stop with a moderate service application.

In making service stops with trains of less than seven cars, the brakes should be released about the time the drivers make the last revolution, except on heavy grades. Even on moderate grades and when stopping at water stations, coaling chutes, short platforms, etc., this should be done, and after releasing re-apply the brakes, either automatic or independent, as required, to prevent the train from starting. To avoid shocks and train parting the brakes must not be released on trains of seven or more cars while moving at a speed of less than 10 miles per hour.

If *undesired quick action* has taken place during a service application on trains of more than five cars, the brakes must not be released until the train comes to a stop.

5. Service Application—Freight Trains.—In applying the brakes to steady the train on descending grades, or for reducing speed for any purpose, an initial brake pipe reduction of not less than 7 lb. must be made. Releasing brakes at low speeds must not be attempted unless local conditions are favorable for same.

Ample time should always be allowed for making the stop, first permitting the slack of train to become adjusted before commencing to use the brake. After this the first brake pipe reduction should be made and it should be sufficiently heavy to make the stop, being not less than 7 or more than 12 lb., according to the length of the train. Then when not more than a car length (40 ft.) short of the completion of the stop, a second reduction sufficiently heavy should be made to cause the brake valve to be blowing when stop is completed. After a reduction to apply brakes, no attempt must be made to release until air ceases to discharge from the brake valve pipe exhaust.

When backing freight trains and it is desired to stop, apply the brake in service, and when conditions permit, keep the driver brake from applying and the throttle open until stop is complete, the idea of keeping the engine brake released and using steam while train brake is applying being to keep the slack of train bunched and thus prevent train parting.

6. Emergency Applications.—The emergency application of the brakes must be used only in actual emergencies. Under such conditions the brake valve must be left in emergency position until train has come to a stop.

ENGINEMEN'S STRAIGHT AIR OR INDEPENDENT BRAKE VALVES.

(A) Always keep both brakes cut in and ready for operation, unless failure of some part requires cutting out.

(B) Always carry an excess pressure of 20 lb. or more, in the main reservoir, as this is necessary to insure a uniformly satisfactory operation.

(C) The straight air or the independent brake valve should not be used for bunching the slack of the train previous to an automatic application; neither should it be used alone for making ordinary stops with a train.

(D) The reducing valves for the straight air and the independent brake and the safety valves for the locomotive brakes should be kept adjusted at the authorized pressures.

When a full application of the straight air or of the independent brake causes any of the safety valves to operate, it indicates that same is out of order, or too high adjustment of the reducing valve or too low adjustment of the safety valve, or leakage of same. Have them tested and adjusted.

7. Brakes Applied From an Unknown Cause.—If it is found that the train is dragging as though the brakes were applied, without rapid falling of the pointer on the brake-pipe air gage, the engineman must make an effort to release the brakes, which may be done as follows: First, if falling of the brake-pipe pressure pointer, the engineman must make an effort to release the brakes, which may be done as follows: First, if brake-pipe pressure is less than the authorized amount and the required excess pressure is carried in the main reservoir, move the handle of the brake valve to release position for an instant and then return it to running position; second, should the brake pipe be fully charged with pressure, apply the brakes with a heavy service reduction, and release them in the usual way. In case the brakes can not be released in this manner, the train must be stopped and the trainmen notified.

If, however, the brakes go on suddenly with a rapid fall of brake-pipe pressure, it is evidence that (A) a conductor's valve has been opened, (B) a hose has burst or other serious leak has occurred, or (C) the train has parted. In such an event the engine throttle should be closed and the brake valve handle immediately placed in lap or in emergency position, to prevent the escape of air from the main reservoir, and left there until the train has stopped and the signal to release has been given.

8. Braking by Hand.—Hand brakes must not be used, except in emergency.

9. Cutting Out Brakes.—*The engine and tender brakes must always be used automatically at every application of the train brake,* unless defective, except upon such grades as shall be designed by special instructions.

When necessary to cut out either the engine or the tender brake, it shall be done by closing the cut-out cock, located between the brake pipe and triple valve, and opening the drain cock in the auxiliary reservoir, on locomotives so equipped. On locomotives having the ET or the LT equipment close the cut-out cock in the pipe leading to the respective brake clinder.

10. Double Headers.—When two or more engines are coupled in the same train, the brakes must be connected through to and operated from the leading engine. Engineman of each engine, except the leading one, must close the double heading cock below the automatic brake valve and carry the handle of brake valve in running position. He will run the compressor for the purpose of maintaining pressure on his engine, and of enabling him to assume charge of the train brakes should occasion require.

11. Dead Engine Feature.—Its purpose is to supply to the main reservoir for operating brakes and other devices on engines where pump has failed, or on dead engines en route. In both cases the cut-off cock in this device must be kept open and handle of both brake valves on such engines left in running position, and the double heading cock below automatic brake valve kept closed.

The dead engine cut-out cock must be kept closed on all engines where pumps are running.

"C"—INSTRUCTIONS TO TRAINMEN.

12. Making Up Trains and Testing Air Brakes.—After the locomotive has been coupled to the train, or after two sections have been coupled together, the brake and signal couplings must be united, the cocks in the brake and signal pipes must all be open, except those at the rear end of the last car, which must be closed, and the hose hung up in the dummy couplings.

After the train has been coupled, stretched, and fully charged, the engineman must be requested to apply the brakes. When he has done so, the brakes of each car must be examined to see if they are properly applied. When it has been ascertained that each brake has been so applied, the engineman should be signaled to release.

In testing passenger train brakes the train air signal whistle code for releasing must be used, and the signals to release must be given from the air signal apparatus on the rear car. The brakes of each car must then be examined to see that each is released, and the en-

gineman informed as to the number of brakes in service and of their condition.

If any defect is discovered it must be remedied and the brakes tested again—the operation being repeated until it is ascertained that everything is right. The conductor and engineman must then be notified that the brakes are all right. Following the separation of couplings for local switching or when engine or train has been parted for any purpose, the above test need not be complied with other than to ascertain, by test, that the rear brakes are responsive to brake valve on engine, and that all brakes have properly released.

No passenger train must be started out from its terminal with the brakes upon any car cut out or in a defective condition. The air brakes must be relied upon to control all trains.

13. Detaching Locomotive or Cars.—First close the cocks in the brake and signal pipes at the point of separation, and then part the couplings by hand.

Couplings Frozen.—If the couplings are found to be frozen together or covered with ice, the ice must first be removed and then the couplings thawed to prevent injury to the gaskets.

14. Brakes Sticking.—If brakes are found sticking, the signal for "brakes sticking" must be given, in which case, if the brakes can not be released from the engine, or if the brakes are applied to detached cars, the release may be effected by opening the release valve in the auxiliary reservoir until the air begins to release through the triple valve, when the valve must be closed.

15. Train Breaking in Two or More Parts.—First close the cock in the brake pipe at the rear of the first section, and then signal the engineman to release the brakes. Having coupled the second section, observe the rules for making up trains—first being sure that the cock in the brake pipe at the rear of second section has been closed, if the train has broken in more than two sections. When the engineman has released the brakes on the second section, the same method must be employed with reference to the third section, and so on. When the train has been once more entirely united the brakes must be inspected on each car to see that all are released before proceeding.

16. Cutting Out the Brakes on a Car.—When necessary to cut out the brake upon any car, close the cut-out cock in the cross-over pipe near the triple valve, and open the drain cock in the auxiliary reservoir, leaving it open on passenger cars.

On freight cars the release valve must be held open until all of the air has escaped from the reservoir, when an air brake defect card must be applied. The conductor must notify the engineman of brake cut-out.

17. Conductor's Valve.—Should it become necessary to apply the brakes from the train, it may be done by opening the conductor's valve in any car so equipped. *The valve must be held open until the train comes to a stop, and then must be closed.*

This method of stopping the train must not be used except in case of emergency.

18. Burst Hose.—In the event of the bursting of a brake hose, it must be replaced and the brakes tested before proceeding, so as to ascertain that the rear brakes are responsible to the brake valve on engine. At least one extra air-brake hose complete should be carried by all crews, and in addition one extra signal hose complete carried by passenger crews.

19. Brakes Not in Use.—When the air brakes are not in use, the hose should be kept coupled between the cars or hung to the dummy couplings, when cars are so equipped.

20. Pressure Retaining Valve.—When this valve is to be used, the trainmen must, at the top of the grade, at point authorized, test the brakes upon the whole train, and must then pass over the train and turn the handles of the pressure-retaining valves upon all or upon a part of the cars, as may be directed, to proper position for retaining pressure. At the foot of the grade, the handles must be turned downward (lengthwise with pipe) again. Special instructions will be issued as to the grades upon which these valves are to be used.

21. Train Air Signal.—In making up trains, all couplings and car discharge valves on the cars must be examined to see if they are tight. Should the car discharge valve upon any car be found defective, it may be cut out by closing the cock in the branch pipe leading to it. The conductor must be notified when the signal has been cut out upon any car, and he must report the same for repairs.

In using the signal, pull down upon the cord during one full second for each intended blast of the signal whistle, and allow three seconds to elapse between the pulls.

22. Reporting Defects to Inspectors.—Any defect in either the air brake or the train air signal apparatus must be reported to the inspector on arrival at terminal; or, if the defect be a serious one in passenger service, it must be reported to the nearest inspector, and such defect must be remedied before the car proceeds.

"D"—INSTRUCTIONS TO ENGINEHOUSE FOREMEN.

23. General.—It is the duty of the enginehouse foreman to know that the air brake and train air signal equipment is properly inspected upon each locomotive after each run, and that necessary repairs are made before leaving the enginehouse. Air gages must be tested at least once every thirty days, and date of testing shown.

24. Air Compressors.—The air compressors must be tested for efficiency by orifice test, and their condition determined.

Compressors must be started slowly with drain cocks open, these cocks to be left open until compressor is free from all condensation. They must also be left open while compressor is not working.

25. Compressor Governor.—The compressor governor should cut off the steam supply when the air pressure for which it is adjusted has been obtained, and promptly admit steam to the compressor when air pressure falls slightly below the authorized amount.

26. Brake Valves.—These valves must be kept clean and be known to be in working order in all their positions before the engine leaves the enginehouse.

27. Adjustment of Brakes.—Engine brake piston travel should not be less than 4 nor more than 6 in.; for tender brake not less than 6 nor more than 8 in. When cam driver brake is in use piston travel should be not less than 2 in. nor more than 3½ in., and care must be taken to adjust both cams alike, so that the point of contact of the cams will be in line with the piston rod; the brake shoes should be correctly adjusted at equal distances from the wheel at the top and bottom of the shoe and in line with the tires.

28. Brake Cylinders and Triple Valves.—Engine and tender brake cylinders, plain triple valves and high-speed reducing valves should be cleaned, lubricated and tested, at least once in six months; when locomotive is equipped with distributing valve or control valve, or the tender has a quick action triple valve, these parts should be cleaned and tested at least once in three months. Time and place of cleaning to be stenciled according to standard drawings.

29. Draining.—The main reservoir, and also the drain cup and dirt collector in the brake pipe under the tender, must be drained of any accumulation after each trip. The auxiliary reservoirs and triple valves must also be drained frequently, and daily in cold weather, and the brake pipe under the engine and tender blown out.

30. Train Air Signal.—The train air signal apparatus must be examined and tested, both at front of engine and rear of tender before every trip, by means of a suitable appliance to which is attached an air gage for testing the pressure carried. It must be known that the whistle responds properly; also that the pressure-reducing valve maintains the authorized pressure.

"E"—INSTRUCTIONS TO INSPECTORS.

31.—General.—It is the duty of all inspectors to see that the couplings, the pipe joints, the triple valves, the high-speed reducing valves, the conductor's valves, the air-signal valves, and all other parts of the brake and signal apparatus are in good order, of standard size for the car, and free from leaks. For this reason they must be tested under the full air pressure as used in service. No passenger train must be allowed to leave a terminal station with the brake upon any car cut out, or in a defective condition.

If a defect is discovered in the brake apparatus of a freight car, which can not be held long enough to give time to correct such defect, the brake must be cut out and the car properly carded, to call the attention of the next inspector to the repairs required.

Special rules will specify the smallest proportion of the total number of freight cars, with the air brakes in good condition, which may be used in operating the train as an air-brake train.

32. Making Up Trains and Testing Brakes.—In making up trains, the coupling must be united and the cocks at the ends of the cars all opened, except at the rear end of the last car, where the cocks must be closed; the inspector must know that the air is passing through the pipes to the rear end, and the hose couplings at the rear are properly attached to the dummy couplings on cars so equipped. After the train is stretched and fully charged, the engineman must be requested to apply the brakes. After the brakes are applied they must be examined upon each car to see that they have the proper piston travel. This having been ascertained, the inspector must signal the engineman to release the brakes.

In testing passenger train brakes, the signal to release must be given from the discharge valve on the rear car. He must then again examine the brakes upon each car to note that all have released. If any defect is discovered, it must be corrected and the testing of the brakes repeated, until they are found to work properly. The inspector must then inform both the engineman and conductor of the number of cars with brakes in good order.

The examination must be repeated if any change is made in the makeup of the train before starting.

33. Cleaning Cylinders, Triple Valve' and Slack Adjusters.—The brake cylinders and triple valves, on freight equipment cars must be cleaned, lubricated and tested, at least once in twelve months, and the method of marking brake apparatus which has been cleaned, lubricated and tested, should be as shown in Rule No. 60, of M. C. B. Rules of Interchange.

On passenger cars, the cylinders, triple valves and slack adjusters must be cleaned and lubricated at least once in six months, and in case cars are equipped with high-speed brakes, the triple, high-speed valves, and control valves, must be cleaned at least once every three months, and date and place of last cleaning stenciled on these parts with white paint.

The triple valves and auxiliary reservoirs must be frequently drained, especially in cold weather, by removing the plug in the bottom of the triple valve and opening the drain cock in the bottom of reservoir.

34. Adjustment of Brakes.—The slack of the brake shoes must be

taken up by means of the truck dead levers on cars having four-wheeled truck and at the turnbuckle nearest the center of the car on cars having six-wheeled trucks.* In taking up such slack it must first be ascertained that the hand brakes are released, and the slack is all taken out of the upper connection, so that the truck levers do not go within one inch of the truck timber or other stop, when the piston of the brake cylinder is fully back at the release position.

When under a full application the brake piston travel is found to exceed 9 in. upon passenger or freight cars, the brake shoe slack must be taken up and adjustment so made that the piston shall travel not less than 6 in. In taking up the brake shoe slack it must never be taken up by means of the hand brakes. Where automatic slack adjusters are applied to any car, such adjuster must be fully released before the slack is taken up elsewhere, and where cars are equipped with double apparatus it must be seen that both slack adjusters are evenly adjusted.

35. Braking Force.—Where the cylinder lever has more than one hole at the outer end and different holes are for use upon cars of different weights. It must be carefully ascertained that the rods are connected to the proper holes, so that the correct braking force shall be exerted upon each car.

36. Repair Parts.—Inspectors must keep constantly on hand for repairs supply of all parts of the brake and signal equipment that are likely to get out of order.

37. Hanging Up Hose.—Inspectors must see that, when cars are being switched or while standing in the yard, the hose is coupled between the cars or properly secured in the dummy couplings, where cars are so equipped.

38. Responsibilities of Inspectors.—Inspectors will be held strictly responsible for the good condition of all the brake and signal apparatus upon cars placed in trains at their stations; they will also make examinations of the brakes, and such repairs as may be required.

NEW TRAIN SIGNALS.

On account of the limited range of action of the present train air signal, the committee desires to bring attention to the need of an improved train signal—this with a view of accelerating the development of a signal device which shall be entirely satisfactory in its operation, such signal to permit of easy and prompt communication both between the train crew and engineman, and the engineman and train crew, under all conditions of service. If it is the desire of the Association that this subject be investigated, this committee will be pleased to do so, and report progress at the next convention.

Committee:—R. B. Kendig (chairman), B. P. Flory, R. K. Reading, T. L. Burton, L. P. Streeter, A. J. Cota, W. J. Hartman.

The report was referred to letter ballot.

TRAIN RESISTANCE AND TONNAGE RATING.

In answer to the circular sent out by the committee replies were received from 35 railroads. The questions and a summary of the replies to same were as follows:

Do you use a formula or curve in arriving at tonnage rating? Give formula and state fully your method of applying.

Twenty railroads use either formulae or curves to determine tonnage ratings. One of these uses the formulae and curves in connection with dynamometer tests.

Have you ever made any dynamometer tests to establish data bearing on resistance of freight cars?

Eleven railroads have made use of dynamometer cars to determine car resistance and tonnage rating.

If no formula or data are used in calculating locomotive tonnage rating, state method used for rating your locomotives.

Thirteen railroads report that their tonnage is determined solely by a practical test.

Do you provide allowance in your ratings for various weather conditions? How is it done?

Thirty railroads reduce their tonnage to provide for weather and unfavorable conditions.

What official directs the rating to be used as weather conditions change?

The superintendent, train master or some transportation officer directs the rating to be used when maximum rating can not be used.

Do you use any system of tonnage adjustment for loaded and empty cars? How was tonnage adjustment derived? How is the tonnage adjustment applied in practice?

Twenty-six railroads use some form of tonnage adjustments to take care of light and heavy cars. The method may be classified as follows: seven use a constant car allowance factor; seven use a variable factor depending on weight of car—two of these obtaining the adjustment automatically from a tonnage calculating machine; three use sets of tables giving tonnage and numbers of cars in train or average weight of cars; two use a car limit; one uses a factor when the number of cars exceeds 24; one uses a limit in average weight per car; three use a factor for empty cars only; one uses a system based on ratio of lading to tare weight; and one uses a positive or negative factor, depending on average weight of cars in train.

Do you use any specially designed calculating machine in handling tonnage rating?

Six railroads make use of machines to compute the tonnage in trains being made up, all but one being simple adding machines, and the exceptions being a device which automatically adds a variable car factor to the actual tonnage.

Manifestly, it is impossible to carefully analyze the conditions existing in each train in order to calculate the number of tons which a locomotive can haul. Therefore, for ordinary purposes, formulae or curves of resistance are prepared for various weights of cars and various speeds. Grade resistance is, of course, a constant, and resistance of cars due to curvature is generally assumed as being constant, based on tests or accepted from some authority. The variation of locomotive drawbar pull with change in speed is taken either from results of test, comparison of dimensions, etc., of locomotive with one tested, or from published curves and formulae.

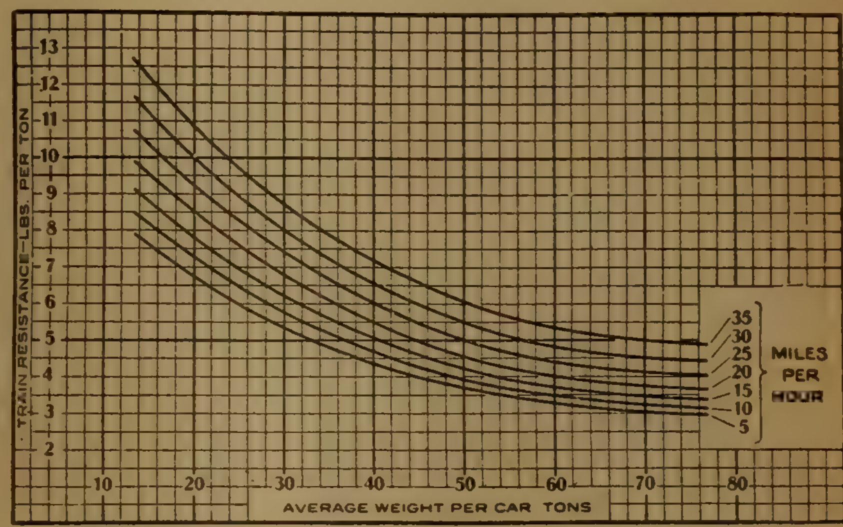


Fig. 1—Relation Between Resistance and Average Car Weight at Various Speeds.

The calculated tonnage is usually checked in practice, and very frequently tonnage is determined by test, without previous calculations.

Occasionally a dynomometer car is used to check the performance of the locomotive with the standard pull-speed curve of the locomotive, in addition to determining the train resistance. This will show whether or not the locomotive is working up to its capacity.

The data available relative to locomotive resistance seems to be very meager, 22½ lb. per ton on drivers being the most generally accepted value for all speeds, resistance on engine truck and trailer wheels being taken as the same as that of the same number of axles under a freight car of equivalent weight. The tender resistance is calculated the same as a freight car.

Where a locomotive is equipped with a superheater it will frequently be found that advantage can be taken of the higher pull speed curve of the locomotive when establishing tonnage rating, this increase will usually have to be determined by actual trial.

Resistance due to grade will be 20 lb. per ton of 2,000 lb. per 1 per cent of ascent. The resistance of cars due to curvature of track depends on various track and speed conditions, 0.8 lb. per ton per degree being much used. For ordinary track, however, 0.9 lb. per ton per degree will be found correct in a great many cases. The curve resistance of locomotive (including tender) is also found to vary. For consolidation locomotives 1.5 lb. per ton per degree will be found nearly correct for average conditions; for locomotives of longer wheel base or having more wheels the resistance will be greater.

It has been found in practice that the resistance per ton light cars is greater than that of heavy cars, and consequently a locomotive can pull more tons of heavy cars at the same speed and over the same tracks.

There are several different ways of covering this point in compiling tonnage ratings, as follows:

Drawbar pull method. In this method the trains of various weights of cars are computed for a locomotive and, due to the varying values of resistance, there will be a different weight of train and number of cars for each average weight of car. The ratings as tabulated are actual tons. This is shown on Table 2.

Adjusted tonnage method. In this method the trains that a locomotive can haul over a given division are determined by either test or calculation for both heavy and light cars, and an adjusted tonnage rating is determined as follows:

Wl = Total weight of loaded or heavy cars in first train.
We = Total weight of empty or light cars in second train.
Nl = Number of loaded cars.
Ne = Number of empty cars.
C = Car allowance or adjustment factor.

$$C = \frac{Wl - We}{Ne - Nl}$$

Adjusted tonnage loaded cars = Wl + Nl x C.
Adjusted tonnage empty cars = We + Ne x C.

The application of this formula is shown in an example under the head of tonnage for cold weather, and it will be found that the adjusted tonnage for loaded cars will be equal to that for empty cars.

Variable car adjustment factor method. In this method a train of cars of some average weight of car is determined for a given locomotive and the actual tons in this train taken as the rating. In order to provide adjustment for lighter or heavier cars, a factor is added to the weight of lighter cars and subtracted from the weight of heavier cars. The value of the factor is made to vary with the weight of the car, being equal to zero for cars of the average weight tested.

This method is in some cases applied in practice by means of a tonnage adding machine which automatically takes care of the adjustment.

In the Lake Shore method of applying the variable car factor, the adjustment is obtained from a tonnage computing machine, correcting as follows:

A 20-ton car registers 23 tons.
A 30-ton car registers 32 tons.
A 40-ton car registers 40 tons.
A 50-ton car registers 48 tons.
A 60-ton car registers 55 tons.
A 70-ton car registers 62 tons.
An 80-ton car registers 66 tons.

The actual and adjusted tons in a train will be the same when the train is composed of cars weighing 40 tons each. The actual tons calculated or determined by test for the locomotive for 40-ton cars will, therefore, be the rating, and the weights of trains of cars of weights other than 40 tons were found by dividing the rating by the adjusted tons per car and proceeding as with the adjusted tonnage method.

In the Philadelphia & Reading method of applying the variable car factor, the adjustment is obtained in much the same way as in the Lake Shore method, except that the constants used are not the same.

Cars weighing from 15 to 19 tons are registered 4 per cent heavy.
Cars weighing from 20 to 24 tons are registered 3 per cent heavy.
Cars weighing from 25 to 28 tons are registered 2 per cent heavy.
Cars weighing from 29 to 33 tons are registered 1 per cent heavy.
Cars weighing from 34 to 48 tons are registered actual weight.
Cars weighing from 49 to 53 tons are registered 1 per cent light.
Cars weighing from 54 to 58 tons are registered 2 per cent light.
Cars weighing from 59 to 64 tons are registered 3 per cent light.
Cars weighing from 65 to 68 tons are registered 4 per cent light.
Cars weighing from 69 to 73 tons are registered 5 per cent light.
Cars weighing from 74 to 77 tons are registered 6 per cent light.
Cars weighing from 78 to 80 tons are registered 7 per cent light.
Cars weighing from 81 to 82 tons are registered 8 per cent light.
Cars weighing from 83 to 85 tons are registered 9 per cent light.

In the Canadian Pacific method of applying the variable car factor the rating is based on cars having load equal to twice the rate weight of the car. In order to compare this with other methods, cars are assumed as weighing 20 tons tare. Then when loaded in accordance with this method, they will have gross weight of 60 tons per car.

From a table current on the Canadian Pacific, upon which tonnages are calculated for grades of 0.5 per cent and under, it is found that when the tare weight of a car is assumed as 20 tons the adjusted weights are as follows:

For total weight of car of 20 tons, adjusted weight is 26 tons.
For total weight of car of 30 tons, adjusted weight is 35 tons.
For total weight of car of 40 tons, adjusted weight is 44 tons.
For total weight of car of 50 tons, adjusted weight is 53 tons.
For total weight of car of 60 tons, adjusted weight is 62 tons.
For total weight of car of 70 tons, adjusted weight is 71 tons.
For total weight of car of 80 tons, adjusted weight is 79 tons.

The adjusted rating is found by dividing the total actual weight of 60-ton cars that the locomotive will haul, as found from the drawbar pull, or 2,150 tons, by 60, which will give the number of cars. The number of cars is then multiplied by the adjusted tons per car for a 60-ton car, which will give the adjusted tons per train. To obtain the actual tons in train of cars of weights other than 60 tons each the same method was used as explained under the Lake Shore method.

Experiments made in 1909 by Prof. E. C. Schmidt on the Illinois Central R. R. indicate that the frictional resistance of freight cars moving at 10 to 12 miles per hour is 50 per cent greater at a temperature of 0° F. than at 70° F., and in any system of tonnage rating this fact should be remembered. At 20 miles per hour the above figure will be increased to 67 per cent.

In addition to the increase in train resistance, the resistance of the locomotive will be increased, resulting in a lower drawbar pull in cold weather. One way of correcting for this is to add to the resistance of the engine truck, trailer and tender the same percentage as for freight cars, for cold weather. With the locomotive 0.8 of 22½ lb. per ton, the friction of driving wheels, rods, etc., or 18 lb. per ton, will be affected by low temperature, and this amount, 18 lb. per ton, should be corrected in the same ratio as the car resistance.

A simple method of correcting drawbar pull for temperatures of 50° F. and below is to deduct 1-2000 of the drawbar pull at 70° and 5 miles per hour for each degree that the temperature is below 70° F.

When a pull-speed curve is used for the locomotive in which the drawbar pull at the rear of the tender is plotted, the resistance at 70° F. should not be deducted from the drawbar pull of the locomotive, but the increase in resistance should be calculated as above outlined and deducted from the drawbar pull, to provide for low temperatures.

When the drawbar pull is calculated, both the resistance at 70° F. and increase in resistance due to low temperature should be deducted from the calculated drawbar pull to find that available at the low temperature.

The tabulation below gives data for empty cars of 20 tons and loaded cars of 72 tons computed as above:

					PER CENTS.			
Temperature.	Flat Tons Loaded Cars.	Flat Tons Empty Cars.	Adjusted Tons.	Car Allowance Factor.	Loaded Cars.	Empty Cars.	Adjusted Tons.	Car Allowance Factor.
70°	2,230	1,665	2,565	10.80	100.0	100.0	100.0	100.0
55°	2,150	1,578	2,499	11.65	96.5	94.6	97.3	108.0
35°	2,045	1,465	2,413	12.95	91.6	87.9	94.0	120.0
20°	1,970	1,395	2,343	13.60	88.4	83.7	91.3	126.0
10°	1,925	1,350	2,305	14.12	86.4	81.0	89.8	131.0
0°	1,885	1,305	2,275	14.85	84.0	78.3	88.5	137.5
–10°	1,840	1,265	2,230	15.22	82.7	76.0	86.8	141.0

While there have been numerous experiments made to determine the resistance of trains due to wind, there is some doubt whether any use can be made in this report of the results, owing to the fact that it is difficult to predetermine the velocity of the wind at any given point and at any time. It is therefore felt that tonnage ratings should be graduated for temperature conditions, as previously outlined, and if at any time severe winds are blowing, or are expected, the tonnage can be reduced to a lower rating accordingly.

Where either the adjusted tonnage method or either of the drawbar pull methods is used a simple adding machine will be found satisfactory, but where a variable car factor is used it will be most easily applied by means of a special tonnage adding machine fitted up to register properly.

In this connection, it should be noted that the machine should be adjusted to suit the tonnage rating of the division, instead of the tonnage rating of the division being altered to the constants of a ready made machine.

DYNAMOMETER TRIALS.

The following suggestions are offered for the use of the dynamometer car:

A. All instruments in car, including dynamometer springs, should be carefully calibrated at intervals sufficiently frequent to insure accuracy of all readings.

B. The locomotive steam gage should be calibrated and diameter of pistons and driving wheels carefully measured.

C. The correction to be made in drawbar pull for acceleration may be applied in accordance with the following formula:

$$F = \frac{(1 \times 0.6w)}{W} \times 31.1 \times \frac{(V_2 + V_1)\ (V_2 - V_1)}{D}$$

where F = Correction in pounds per ton.
W = weight of car in tons.
w = weight of wheels under car in tons.
V_1 = initial velocity feet per second.
V_2 = final velocity feet per second.
D = Distance of acceleration or retardation.
Constants are based on 33-in. wheels.

Another formula which is easily applied in working up dynamometer records is:

$$F = \frac{91.1}{t}\ (V_2 - V_1)\ (Tt + 1.68\ N)$$

where F = Correction in pounds for whole train.
t = time in seconds between readings V_1 and V_2.
V_1 = initial velocity—miles per hour.
V_2 = final velocity—miles per hour.
Tt = weight of train in tons.
N = number of cars in train.
Constant 1.68 is based on 5½ x 10 in. axles and 33-in. wheels.

Where F is positive, it should be subtracted from the drawbar pull and when negative it should be added to the drawbar pull.

D. When a dynamometer test is made, the track should be carefully checked against the profile and alignment, so that the proper corrections can be made in drawbar pull values for grade; and if curvature resistance is computed, the correct value can be obtained.

In working up such tests, the actual grade going around a curve should be used and the actual curvature noted, as the compensation of the curve, if any, is based on some assumed value of resistance per ton per degree of curvature which may or may not be true for the case in question.

In any calculation involving train resistance on curves, only the part of the train which is actually on the curve should be considered.

It will in many cases be found that a ruling grade can be approached at a fairly high speed, say from 25 to 45 miles per hour. Where this initial speed can be depended upon, it will, of course, be possible to haul heavier trains than those calculated for a constant speed or dead pull.

The formula used in such a calculation is:

$$Gm = 3.5 \times \frac{V_1^2 - V_2^2}{L}$$

where Gm = per cent of grade to be deducted from actual grade.
V_1 = initial speed in miles per hour.
V_2 = speed at top of grade in miles per hour.
L = length of grade in feet.

Having found Gm as above, the equivalent grade is found by deducting Gm from the actual grade, and tonnage rating is calculated for the equivalent grade, as previously outlined.

Physical relations of rise in feet to length of grade in connection with possible initial speed will have to be considered when determining whether or not a grade can be handled in this manner. Other considerations in this connection are the location of stations, towers, water tanks, sidings and block signals, which, if located on the grade, will prevent its being considered as a velocity grade.

The various traffic conditions, such as frequency of trains, single or multiple track, and average speed between terminals will all have a bearing on the subject.

There have been several methods suggested of rating locomotives by calculated steep curves. These are open to the objection that the constants used are not correct, as they do not provide for the variations in pull per ton with weight of car, and that it is necessary to assume a given weight of train and make calculations for acceleration and retardation curves for all grades found on the divisions and finally with these curves to plot a speed curve over the division profile to ascertain the time between stations.

In view of the amount of theoretical labor involved in the above, it seems that a better way would be to make up some test trains, either by a simple calculation or according to the judgment of some experienced traffic officer, and run them over the road, keeping careful observations of speed by means of a reliable speed recorder. If a dynamometer car is available, it can be used to ascertain if the locomotive is keeping up to the proper drawbar pull.

Recommendations.

(a) To compute the tonnage rating for a division, it is recommended that for track having heavy rails and roadbed with a high degree of maintenance, the car resistance curves shown on Fig. 1 be used.

(b) For weather conditions, provision should be made by making calculations as previously outlined.

(c) If the traffic will permit, the calculation of ruling grades as velocity grades is recommended, as it will permit the addition of several cars to the train.

(d) Where desired, speed curves can be plotted for assumed trains over the division. The principal value of this will be in connection with fast freight trains. On account of the great amount of labor involved, it being necessary to make a complete set of calculations for each train assumed, the committee is not strongly inclined to recommend this method, and mention of it has been made only for the purpose of pointing out to the Association a possible way of determining tonnage rating.

(e) After tonnage ratings have been calculated, it is strongly recommended that before being finally adopted several practical tests be run of trains made up in accordance with the new rating. The use of a dynamometer car or speed recorder in such trials is recommended, in order to show: (1) whether the locomotive is working up to its capacity at all times; (2) whether the locomotive is loaded to its capacity on the ruling grades.

(f) On railroads having a dynamometer car at their disposal, tests may be made and from the results of such trials locomotive pull-speed and train resistance curves may be made up and the practical rating checked by calculation. In this it is, of course, necessary to use the standard diameters of cylinders and driving wheels and disregard the locomotives having cylinders worn large and driving wheels worn small. The division constants found on one division may safely be used on another division with the same characteristics. Where they are different, it is well to make an estimate of the difference or to make additional trials.

Committee:—P. F. Smith (chairman), W. E. Dunham, E. J. Searles, H. C. Manchester, C. E. Chambers, J. H. Manning, Frank Zeleny.

There was some discussion as to the advisability of accepting the recommendations and the report was referred back to the committee for further investigation.

FUEL ECONOMY.

In the preparation of this report, a list of 17 questions was sent out to the mechanical department heads of the railroads. The questions, with a digest of the answers, are given below.

Question 1.—What fuel economies can be obtained from the following:

Good Boiler Conditions.—There is no doubt that clean boilers contribute largely to fuel economy; and it is certain that scale formation leads to broken staybolts, leaky tubes, seams and mud rings, with the consequent loss of boiler efficiency and increased fuel consumption for a given amount of evaporation.

Experiments conducted by the United States Government show the following costs for producing 100 horse-power for 3,000 hours, with coal at $1.50 per ton, for a clean boiler and with various thickness of scale, as follows:

Thickness of Scale.	Cost.	Increased Cost.
0 inch	$1,269.99	....
1/16 inch	1,459.00	14.88 per cent
¼ inch	2,030.00	59.84 per cent

These data clearly demonstrate the point in question, and show that every 1/16 in. of scale on the heating surface of the boiler requires 15 per cent more fuel than would be required if the boiler was entirely free from scale.

The nature of the scale formed has a decided influence on the efficiency of the heating surfaces. In some localities, the water used for locomotive boiler feed contains a certain amount of decayed vegetable matter, and the scale is somewhat soft and porous. The loss of fuel is very much less, with this sort of scale than with hard scale, the effect of which was the subject of investigation in the experiments just mentioned.

Scale prevention and careful boiler maintenance have a very marked bearing on fuel economy, perhaps more than any other item in connection with the locomotive itself.

Good Water Conditions.—Good boiler feed-water, together with thorough cleaning of boilers by washing out, keeps the amount of scale formed down to a minimum, and, as previously shown, contributes largely to fuel economy.

Good Machinery Conditions.—Keeping the valve gear in good condition, in order to obtain correct steam distribution, and by proper lubrication, to prevent hot bearings, the friction or internal losses in the locomotive will be reduced to a minimum. The effect of this on the amount of fuel burned is self-evident.

Superheaters.—Tests of superheater locomotives in both passenger and freight service have shown a saving in fuel, for a unit amount of work done, amounting to as much as 25 per cent. Somewhat less than this must be expected in regular service, because in every-day operation the approach to the results achieved by tests will be governed by the essential factors of good firing, proper handling of the locomotive and maintenance.

Superheaters make it possible to get a higher sustained tractive power out of a locomotive. The savings resulting from their use, therefore, would not show upon a locomotive mileage basis, but would appear when figured on a ton-mile basis, which is, to a certain extent, proportional to the work done.

Preheaters and Feed-Water Heaters.—Accurate data relative to these devices are so limited, as to be of little value. It can be said, therefore, that experience has not yet justified their application to locomotives generally.

Outside Valve Gear.—Outside valve gear has some influence on fuel economy, because it holds its adjustment and consequently gives a better steam distribution. While certain economies are known to result from its use, the percentage is more or less indeterminate.

Brick Arches.—It is generally agreed that about 10 per cent fuel economy can be obtained from the use of the brick arch. But there are other advantages which should not be lost sight of. It affords considerable protection to the flues, by keeping them at a nearly constant temperature and thus prevents certain losses due to leaks; also the arch tubes give increased heating surface of the most valuable kind.

Mechanical Stokers.—In the ordinary interpretation of the term "fuel economy" it is doubtful whether savings can be claimed for the mechanical stoker. Its chief merit is its capacity for firing larger quantities of coal than can be handled by a fireman.

It is believed that the application of the mechanical stoker will be greatly extended in the future. Until then the advantages of the device will be more or less a matter of conjecture.

Special Appliances.—Special appliances, such as automatic fire doors, power reverse gears, rectangular and variable exhaust nozzles, and smoke-consuming devices, all have a tendency to produce fuel economy, as they make work of the enginemen easier and improve the operation of the locomotive itself.

Properly drafted locomotives should steam freely, provided they are correctly proportioned, and therefore a study of each class of locomotive, to the end of giving it an efficient set of draft appliances, will materially assist in producing a saving in fuel.

Among special appliances might also be mentioned a recording device attached to the safety valve to show how long the valve has been open during any stated period. The railroad with which the chairman of the committee is associated has had a device of this nature on one of its passenger locomotives for some time. The record made by the instrument is very impressive and admits of no argument. It enables the enginemen to be accurately informed of the amount of waste caused by unnecessary popping, and it goes a long way to assist in making instructions along this line effective. A 3-inch safety valve

on a boiler carrying 200 pounds pressure will waste 146.7 lb. of steam and about 20 lb. of coal every minute during which it is open. When it is considered that from 7,000 to 20,000 lb. of coal are wasted each month on a single locomotive, it is evident that the matter of loss through safety valves is something worthy of close attention and offers an opportunity to effect a considerable saving.

QUESTION 2.—What methods of supervision are in vogue on your road or in your territory to promote the greatest measures of fuel economy; who are responsible; and to whom do they report?

Several railroads have organized their fuel departments, and placed in charge a fuel engineer, or a superintendent of locomotive operation. This officer reports to the head of the mechanical department. The fuel department has jurisdiction over matters relating to the proper operation of locomotives, economies in fuel, lubricants, other supplies and kindred subjects. The fuel department consists of the chief officers, above mentioned, and a corps of men who report to him and who devote their entire time to securing results along the lines previously mentioned.

One road has a superintendent of locomotive operation who visits the several division terminals periodically and lectures to the enginemen on the methods of performing their duties in the manner to secure economies in operation. These lectures are elucidated by stereopticon views, and moving pictures are used to illustrate the proper and improper ways of doing work.

On some roads a traveling engineer and a traveling fireman are assigned to each main division, and in some cases they have to cover side lines as well. While other railroads do not require these men to cover so much territory, the plan is not necessarily inefficient, because a great deal depends upon the spirit which the supervising officers are able to work up among the engineers and firemen.

The railroad with which the chairman of the committee is connected has quite an extensive organization of this character. At the head of the department is a superintendent of locomotive operation who reports to the general mechanical superintendent. Under this officer are supervisors of locomotive operation and road foremen of engines, who receive instructions, both from him and from the master mechanics.

QUESTION 3.—Instruction and encouragement in locomotive operation. What program have you installed? By whom and in what manner are instructions given to enginemen?

Speaking further of the railroad with which the chairman of the committee is identified:

The plan of supervision requires the assignment of at least one supervisor of locomotive operation or road foreman of engines to every 50 engine crews or less, each man having supervision over one specific class of service, namely, passenger, freight or switch. Their duties cover instruction of enginemen in the proper methods of firing, efficient handling of the locomotive, and operation of fuel-saving devices. They hold periodic class meetings at the different terminals, where the road instruction is carried further by lectures.

Enginemen receive encouragement by a system which has been in vogue on this road for several years. When an engineer has had a record which comes up to a certain fixed standard, the number plate of his locomotive is painted red, indicating that he is a member of the order of the "Red Spot." The rules governing this order are briefly as follows:

1. A good performance in operating the locomotive, both in controlling the work of the fireman and in performing his own duties so as to obtain the greatest efficiency in operation.

2. His record must show no engine failure, for which he is directly responsible, during the preceding six months. Cleanliness is also an essential.

3. They are required to make a study of the four leading economies over which they have control; namely, fuel, lubrication, tools and other supplies, and maintenance and shop cost of locomotives.

4. Membership shall be chosen and published on the first day of each month by a committee composed of a master mechanic, a supervisor of locomotive operation or a road foreman of engines, a trainmaster, a chief dispatcher and a superintendent (ex officio).

5. Engineers or firemen in charge of a "Red Spot" locomotive becoming amenable to discipline shall receive the following benefits:

Record Suspension	None.
Actual Suspension	Reduced one-half.
Dismissal	Due consideration.

If any offense warrants the application of the above modified discipline, the locomotive loses its "Red Spot," but it may be changed back at the beginning of any month by recommendation of the committee.

After an engineer has belonged to the order a sufficient length of time to warrant it, his name is placed on the cab of his locomotive in letters of gold. This is the highest position in the order.

QUESTION 4.—Do you advise class or individual instruction.

Give reasons.

Class or individual instruction is very essential to promote the greatest degree of fuel economy, and in most cases, both are given. Individual instruction is preferred. However, in order to create a lasting impression and obtain the best results, instruction should be followed up invariably by practical demonstration. Locomotive class instruction at terminals is growing in favor. This practice is justified for several reasons:

1. It makes it possible to group, or divide, the men into classes, associating those who have equal experience, the same turn of mind and a parity of mental grasp.

2. Relatively, more work can be presented and assimilated in a given period by the men, which saves the time of the instructing officer.

3. It brings out the views of the several members of the class and all benefit by the discussion of them.

4. It affords an opportunity to take up operating questions, which makes the meetings interesting to all employes in train service.

QUESTION 5.—What methods are used to instruct enginemen, firemen, hostlers and engine preparers, when first entering the service, on the properties of fuel and the system to be practiced to secure the best results? What progressive system of examination do you use in following this up?

Firemen are usually employed by the road foreman or supervisors of locomotive operation and before going into regular service they are given some preliminary instructions and practice. They are required to make a stated number of trips as a student fireman with an engineer competent to instruct them in the proper methods of firing. Instruction books treating on combustion and fuel economy are furnished to all engineers. These books and a set of standard instructions, operating rules, book on good firing, firing charts and other information are given to new firemen. A supervisor or road foreman or fireman instructor generally rides with the new fireman for one or two trips in order to get him properly started and to teach him the fundamentals of the art of firing.

New engine preparers and hostlers are taught to keep the fire in good condition so that the locomotive may be properly handled at the terminal without waste of steam through the pop valve or through the improper use of the throttle.

Most roads have what are called progressive series of examinations, that is, examinations pertaining to the firing and operation of locomotives, which each fireman must pass before he can be promoted to fill the position of engineer. The first two years are generally devoted to questions of combustion and fuel economy, while the third year covers the subject of air brakes, the mechanical parts and operation of the locomotive. Examinations are conducted by the supervisors and road foremen and are followed by the trainmaster or chief dispatcher who gives a thorough examination of train rules and signaling, after which the candidate, if qualified, is ready for promotion.

The chairman of the committee at one time had occasion to investigate the methods of employment on the Metropolitan Street Railway Lines in the city of New York. All candidates for the position of motorman and conductor were required to attend a school for a period of 15 to 30 days where they received instruction in the methods of operation and handling of equipment. If they passed the required examinations, they received one-half pay for the period of instruction; if they failed to pass, they did not receive any compensation and were taken out of the service. It would seem, therefore, that if a great street railway system deemed it advisable to instruct candidates, not only to prepare them to enter its service but to test them for fitness for employment, it might be equally essential that men, seeking the position of firemen, should be similarly instructed and judged before they were given employment. The instruction should cover transportation rules and signaling as well as the rudiments of proper firing. Certainly the instruction of new firemen should receive more serious consideration than has been the case heretofore.

QUESTION 6.—Please name the method by which you require engineers and firemen to co-operate to avoid loss and waste of fuel and unnecessary firing?

The general practice is to hold the engineer responsible for the coal records and to see that he instructs his fireman along proper lines. Engineer and fireman should be made to understand that harmony in the cab is necessary in order to accomplish the desired results in fuel economy.

They should examine their records on the performance sheet and be inspired by force of precept and example to make as good a showing, if not a better one, than the other engineers whose names appear on the same record. The general aim should be to proceed along the missionary plan as much as possible, imposing discipline only, as a last resort, where instructions have been wilfully disregarded.

QUESTION 7.—Is it considered, from your experience, good practice to generally inform your engineers and fireman by circulars or charts of the temperatures that can be obtained in the firebox of a locomotive by the varying degrees of heat and the color of the flame?

There is a difference of opinion on this question. However, the majority of the replies received indicate that, as an educational measure, it is of value to impart such information to engine crews and it is worth while to give this matter close study and attention.

QUESTION 8.—Does your company make up an individual performance sheet, monthly, showing the cost of fuel per ton and per locomotive mile, making comparison between the engineers on each division of the road from month to month?

Some roads compile data and make up an individual performance sheet, monthly, showing comparison of engineers in different classes of

service on each operating division, based upon the consumption of fuel, lubricating materials and other supplies. Some consider this a good means of checking the results as between individuals, while others take the opposite view, claiming that there is a great lack of accuracy in the data secured and that when figures are not reliable the data are without value. Nevertheless, a number of the railroads are of the opinion that when the figures presented are even approximately correct, an individual performance sheet affords the best known means of checking the savings and losses made by enginemen and gives a record by which the engineers can check themselves with other men on the same division and in the same class of service, thereby spurring them on to make greater efforts to secure economies and better their showing.

QUESTION 9.—Are money premiums or prizes of any sort employed by your road as an incentive to engineers to improve and maintain a good fuel record? If so, of what do they consist?

There seems to be a universal sentiment opposed to a plan of this nature. High-salaried, intelligent employes who do not make all possible economies in the operation of locomotives are doing themselves an injustice. The giving of money premiums or prizes of any character might lead the engineers into the use of unfair means, thereby introducing corruption into the ranks.

QUESTION 10.—What influence, in your opinion, has the preparation of coal in small, convenient sizes for use in making a good fuel record? what is your practice?

The nature of the coal in different localities, in many instances, makes a general hard and fast rule governing the size of coal used on locomotives impossible. Illinois coal, if broken up into small sizes at the mine, would be practically pulverized by the time it reached the locomotive. In other districts, the coal is very hard and the case would be quite different. In many regions, therefore, the size of coal used must be governed entirely by local conditions.

However, the committee is of the opinion that, wherever conditions will permit, the bituminous coal should be broken into small, convenient sizes, in order to secure the best results from hand or stoker firing, because the smaller lumps burn more readily and tend to produce a greater evaporation per pound of coal. The best sized coal seems to be that which will pass through a 1¼ in. and over a ¾ in. screen. For anthracite burning locomotives, egg size, or that which will pass through a 2¾ in. and over a 2 in. screen, seems to be generally considered best. For a mixture of anthracite and bituminous coal, a general rule is difficult to state, because so many variables enter into the proposition.

QUESTION 11.—Which, in your opinion, will make the best fuel record; run-of-mine coal or coal that has passed over a ¾-inch screen? If you consider run-of-mine will show most economy, give maximum per cent of slack that can be used to bring about that economy.

There is a considerable difference of opinion on this question; the majority believing that coal run over a ¾-inch screen will make a better record than run-of-mine coal on a basis of pounds of coal burned, but if the price is considered, run-of-mine coal containing not above 30 per cent slack will make the best record.

QUESTION 12.—What do you consider the most valuable essential of fuel economy? Why and what methods are used to obtain this result?

While skillful operation of the locomotive, both by the engineer and fireman, coupled with careful maintenance of the locomotive, play a very important part in fuel economy, it is probable that good supervision is the most valuable essential in fuel economy. A carefully developed system of education taught to the enginemen, by supervising officers of the right caliber, will result in skillful operation and co-operation between engineers and firemen. Savings of a most gratifying nature will be bound to follow.

QUESTION 13.—Mention any device or appliance for use on engines or tenders to prevent waste en route and at coaling stations. What results are obtained from same?

It is not possible to give any definite savings resulting from the use of various coal-saving devices, but it is certain that the following materially assist in the fuel economy campaign:

Iron or wooden coal gates of good design.

Fenders on tender platforms and inside of gangways to keep coal from falling off. Movable covers over shaker bar openings, or collars around same. Prevention of overloading of tenders.

QUESTION 14.—Have you any economical device for pushing coal forward in the tender and what economies can be effected by their use?

As a general rule, the railroads do not have any device for pushing coal forward on the tenders. However, some roads have experimented with various types of mechanical coal-pushers, but the results are not, as yet, conclusive.

QUESTION 15.—Is the weathering of stored coal a material consideration in fuel economy? What is the percentage of loss in the different kinds and grades of bituminous and anthracite coal?

The only advantage to be gained by storage of coal is that it provides a supply of fuel during periods of strikes or shortage.

All authorities agree that coal deteriorates in storage, but the loss of heat value is not very great. Coal storage is detrimental to fuel economy for the following reasons:

Cost of fuel is increased on account of double handling.

Spontaneous combustion is liable to occur during which some of the coal is lost.

Bituminous coal loses some of its efficiency due to slacking.

When coal is stored on the ground, a considerable amount of dirt is apt to be picked up with it, thus reducing its value as fuel.

QUESTION 16.—Do you furnish an analysis of the constituent parts of coal to your engineers and firemen, and do you consider this practice of value?

As a rule, the railroads do not follow this practice, because data of this sort are not considered of much value to the enginemen. Some roads, however, do follow the practice and claim satisfactory results.

QUESTION 17.—Do you consider it of importance to furnish your engineers and firemen an analysis of the gases of combustion, so as to show their relative heat value and consequent loss when consumed?

It has been found generally very important to instruct engineers and firemen in the principles of combustion. They should be made to understand how the gases of combustion influence the color of the fire and that unburned gases cause black smoke. This subject should be thoroughly covered in the instruction books on fuel economy, as well as in the individual and class instruction.

CONCLUSIONS.

Care should be exercised always to have fuel furnished according to a rigid specification and this should be further followed by close inspection at the mines. Proper grades of fuel should be maintained for each class of service as far as possible in order to keep the efficiency of both the enginemen and the locomotives as high as possible.

Too much care can not be exercised in keeping accurate coal records, especially at coaling stations. At the same time losses in fuel by overloading tenders and careless handling of locomotives at terminals should be stopped as far as possible. Fuel savings must be made by all concerned and not by the enginemen alone, if the coal bills are to be reduced as much as they can be.

The boiler fuel-water should be improved wherever possible, and if necessary good treating plants should be installed. The savings resulting from reduction of scale and decreased boiler maintenance will pay the cost of treating boiled feed-water where necessary. Suitably located blow-off cocks of good design are also a great aid in keeping down boiler scale.

Emphasis should be laid upon the necessity of close co-operation between engineers and firemen, and between these men and their supervising officers; strict adherence to the proper methods of operating locomotives, proper care and adjustment of lubricators to avoid damage to valves, valve seats and piston packing; and the maintenance of standard adjustments of front end arrangements, exhaust nozzles and other parts essential in producing free steaming locomotives. Definite assignments of the most suitable classes of locomotives to each division, and as far as possible, assignment of regular crews to locomotives, are great aids in fuel economy, for reasons too well known to need discussion here.

The recent successful application of powdered fuel to industrial plants points the way to large savings in locomotive fuel consumption, provided the system can be successfully adapted to this kind of service. Although there will be an increase in cost per ton due to pulverizing the coal, the expected savings should more than offset this. Some of the advantages claimed for powdered fuel are:

Greater capacity of locomotive, and lightening the work of the fireman.

Reduced fuel consumption due to more perfect combustion, and elimination of standby losses.

Reduction of smoke.

Ease of handling.

Notwithstanding the mechanical aids to effect economy of fuel, it is a settled fact that a well organized department, invested with full charge of the fuel problem, and nothing else, will accomplish material results. Experience of many roads proves conclusively that the institution of such a department is followed by savings which abundantly justify the expense of the administrative and supervising organization.

The committee has deemed it advisable to discuss only the most essential points of this absorbing question, believing that the less important phases may well be omitted in a paper presented to this association. The membership is fairly familiar with the subject, generally, and it is thought that exhaustive detail would only take up the time of the convention to no purpose.

Committee:—WM. SCHLAFGE (chairman), W. H. FETNER, D. M. PERINE, R. QUAYLE, S. G. THOMSON, D. J. REDDING.

The discussion showed that a number took exception to the purchase of coal under specification as there were many other factors to be taken into consideration in the railway field.

The report was accepted and the committee made a standing one.

SUPERHEATER AND BRICK ARCH TESTS, N. & W. RY.

By H. W. Coddington, Engineer of Tests, Norfolk & Western Ry.

In the summer of 1913, there was conducted upon the Norfolk & Western Railway a series of tests for the purpose of determining the relative performance of the superheated and non-superheated locomotives in the same service. In connection with the superheated test, there also was featured the subject of the brick arch.

In selecting a superheated locomotive for this test, there was se-

cured a simple twelve-wheel freight, 4-8-0 type locomotive. This locomotive is one of six of the same type built at the Roanoke shops of the Norfolk & Western Railway and equipped with a Schmidt superheater. The non-superheater locomotive which figures in the comparison was of the same identical type, except it was not equipped with a superheater. Both locomotives, prepartory to the tests, were brought into the shops and given a thorough overhauling, after wheich they were given some preliminary service in order to break them in before introducing them into the test service.

It is a recognized practice on the Norfolk & Western in conducting locomotive tests in which particularly accurate information is desired, to confine the test to carefully conducted short trips rather than division runs, as it has been established, from tests of both characters, that data of a much more dependable nature can be obtained from short runs. This is due to the ability to make the runs with few delays and with the engine working steam continuously. The district selected for making these locomotive tests is between Roanoke and Christiansburg, a district twenty-nine miles long, seventeen miles of which is comparatively level or undulating grade, where the engine can be observed under what is termed moderately high-speed conditions. The remaining twelve miles is on an almost uniform grade of 1.32 per cent up Allegheny mountain from Elliston to Christiansburg. In this particular district the engine is worked under maximum conditions, the amount of tonnage hauled being governed by what can be handled successfully on the twelve miles of heavy grade.

In conducting these tests, special effort was made to operate the locomotive with as little interference as possible from delays other than that necessary to take water at Elliston. It was found, from experience, that numerous delays influence the results to a considerable degree, and no successful method has been established for making correction for such conditions. In the tests made upon engine No. 1136, no little trouble was experienced on account of numerous delays, so in order to overcome this condition when the test of engine No. 1160 was conducted, arrangements were made to run the test train as a second section of local passenger train No. 1 from Roanoke to Christianburg. In this way, the operation was under most ideal conditions as far as the delays were concerned.

The tank used in connection with the tests was carefully calibrated in increments of four hundred pounds of water. Gage boards were attached at each corner of the tank. The coal used throughout each test was Pocahontas run-of-mine. The fuel was sacked and carefully weighed one hundred pounds to each sack, and was delivered to the fireman upon the fuel deck in one-hundred pound quantities as required. A special effort was made to always have a clean, uniform condition of fire at the beginning of the test, and it was further endeavored to restore the fire as nearly as possible to its original condition at the end of the run. Fuel that was used during delays was accounted for separately. An electric connection operated by the man handling the coal registered on the dynamometer chart each one hundred pounds of coal as emptied. By this method, observers in the dynamometer car were advised of the rate of firing.

In arriving at the consumption of steam through the cylinders, it was necessary to make corrections for the amount of steam used by the accessory apparatus operating in conjunction with the locomotive. The items to be accounted for in this respect are—injector overflow, consumption of steam by air compressors, calorimeter, blower and pop discharge.

In determining the temperature of the flue gases in the smoke box, we employed Hoskins pyrometer elements. In making the test of engine No. 1136, it was observed that while the elements were calibrated for accuracy before the test, yet a recalibration of the instruments after the test discovered considerable error in the instruments. For this reason, we do not place any great dependence upon flue gas temperatures as shown for engine No. 1136.

In establishing the quality of steam, a Peabody throttling calorimeter was employed. The calorimeter was connected to the live steam passage in the cylinder saddle on the non-superheated locomotive No. 1136.

The notches on the reverse bar quadrant were numbered counting from the center. The throttle opening was determined by removing the dome cap when the locomotive was in the shops. The throttle valve was then adjusted to 1/8, 1/4, 3/8, etc., opening and the throttle-valve stem in the locomotive cab graduated accordingly. This gave a graduation in the cab by which the throttle opening could be conveniently observed. The positions of the reverse bar and throttle were noted by an observer in the locomotive cab and were also registered on the dynamometer chart by the same observer operating an electric contact point to give this registration. Whenever a change was made in the throttle or reverse bar position, a registration was accordingly made on the dynamometer chart indicating the change.

Crosby steam indicators were used in connection with these tests, one indicator attached to each cylinder. Each indicator was connected to both the head and the crank end of the cylinder as well as the steam chest. These indicators were specially fitted with a circuit closer on one end and an electro-magnet on the other so that diagrams could be taken simultaneously on each side of the locomotive. This electric circuit was extended to and connected with an electro-magnet on the dynamometer instrument which registered the operation of the indicators on the dynamometer chart. When the observer handling the indicator with the circuit closed operated his instrument, the circuit was completed and the other indicator and dynamometer instrument operated at the same time. In this manner, both indicator cards were taken at identically the same instant on each side of the locomotive and a record made on the dynamometer chart at the instant the indicators were operating in this way, the exact relation between the indicated and dynamometer horsepower can be accurately established.

An observer in the dynamometer car announced the time of passing each mile post and other landmarks desired, as well as the time of all starts and stops. These time announcements were entered upon the dynamometer chart record which shows the location of mile posts and other landmarks with respect to the operation of the engine as previously outlined.

A signal system was established between the observer in the dynamometer car and those on the locomotive so that observations could be made simultaneously. Upon approaching a location where indicator diagrams and complete observations were desired, the observer in the dynamometer car would press a master button which operated electric bells where each observer was located. This was the observers' announcement to prepare for action. As each observer became prepared for his particular duty he would press a button located at his station and through an annunciator in the dynamometer car indicated his readiness to proceed. When all the stations had rung in announcing they were ready, the master button was again operated by the observer in the dynamometer car when the desired location was reached and readings were made at that instant. When the observation was complete, the announcement was communicated through the annunciator to the observer in the dynamometer car. In this manner there was established an understanding as to the general conditions upon the locomotive with respect to the proper working of the instruments and other apparatus.

A regular engine crew was assigned to this work in order that the fuel consumption would not be influenced by the different methods of firing as practiced by different firemen and also to provide an engineman familiar with the work who would be interested in handling and operating the engine in a uniform manner. After the run was once established, the engine was worked under the same conditions as regards reverse bar and throttling opening for all the succeeding runs. The relative position of the reverse bar and throttle was decidedly different between the non-superheated and superheated locomotives, as it was soon established with the superheated locomotive, that best results were secured by operating under full throttle conditions all the time and controlling the speed and locomotive performance by the reverse bar or cut-off.

[Only the final general results are reprinted herewith.]

In the results one principal feature characterizes the comparison, and that is the remarkable increased performance of the superheated locomotive. The table gives a summation of significant differences between the performance of superheated and non-superheated locomotives.

It contains a list of twenty-three items which are of particular interest in the comparison of superheated and non-superheated locomotives. The values for these items are given for both the superheated and non-superheated performance and at the extreme right of the sheet is shown the per cent of difference between the performance of the two. The differences preceded by a plus sign (+) indicate the items which have shown a difference favorable to the superheated locomotive. Those preceded by the minus sign (—) represent differences favorable to the non-superheated locomotive.

In glancing over the "per cent difference" column, only two items are observed which show favorable to the non-superheated locomotive. These items are "Equivalent evaporation per pound of Dry Coal," and "Boiler Efficiency," respectively. The reason for this difference, as already explained, is the result of the reduction in tube heating surface which accompanied the installation of the superheater. In review of the differences favorable to the superheated locomotive attention will only be called to a few of these items which are 16.1 per cent more tonnage, 30.1 per cent increased speed, 26.8 per cent less coal per thousand ton miles, and 41.8 per cent less steam through cylinders per thousand ton miles. These are the items of real significance and value which appear in the table.

	Eng. 1160 Superheated.	Eng. 1136 Non-Superheated.	Per cent* Difference.
Boiler pressure	199.2	192.7	+ 3.3
Tonnage hauled	1198.9	1032.0	+16.1
Speed M P H	19.23	14.78	+30.1
Coal per M T Mile	244.3	334.0	+26.8
Water supplied to boiler	49.622.0	74,551.0	+33.4
Equivalent evaporation per lb of dry coal	7.51	8.22	— 9.7
Boiler efficiency	52.5	59.9	—12.3
Steam thru cylinders	45,257.0	68,366.0	+33.6
Steam thru cylinders per M T car mile	1.270.0	2.184.0	+41.8
B t u thru cylinders per M T Ml.	1,410,213.0	2,188,011.0	+35.5

Indicated H P average for run	1,609.9	1,182.8	+36.1
Draw bar H P average for run	1,410.2	1,104.5	+40.4
Steam per I H P per hour-actual	20.0	28.2	+29.1
Steam per I H P per hour-equiv	25.9	35.5	+27.0
Mechanical efficiency	87.58	84.98	+ 3.0
Thermal efficiency I H P basis	5.31	4.29	+23.8
Thermal efficiency D B H P basis	4.65	3.65	+27.4
Fuel burned per hour	5,635.0	5,097.0	+10.5
Fuel burned per Sq Ft grate area per hour	125.2	113.2	+10.6
Fuel burned per hour—High speed condition	5,243.0	4,699.0	+11.6
Fuel burned per hour—Low speed condition	5,941.0	5,347.0	+11.1
Fuel burned per Sq Ft of grate area per hour—Low speed	132.0	119.0	+10.9
Fuel burned per Sq Ft of grate area per hour—High speed	116.5	104.4	+11.6

*All differences preceded by plus (+) are favorable to the superheated locomotive.

Considering the increased speed of the superheated locomotive, it is naturally expected the rate of coal consumption to run somewhat higher than on the slower operating non-superheated locomotive. The difference in the amount of coal burned, both total and per square foot of grate per hour, for both high and low speed service shows an increase of approximately 11 per cent for the superheated locomotive. The rate of firing in the heavy grade service for the superheated locomotive was 5941 lb., or approximately three tons of coal per hour, but this rate of firing covered a period of little less than an hour.

In summing up conclusions, the considerations relating to the brick arch should first be disposed of. There was an indication of a 5 per cent saving in coal per thousand ton miles in the performance of the superheated locomotive with a brick arch, as compared with the same superheated locomotive without the brick arch. While the influence of the arch does not affect the coal consumption to any marked extent, yet we must recognize that there are other features favorable to the arch installation, such as the protection of the flues from sudden changes of temperature and also from stopping up, which advantages are well worthy of consideration. While a small difference in fuel consumption of 5 per cent seems an insignificant quantity, yet when that difference is applied to a large coal consumption, the figures become quite appreciable.

Attention is called to the fact that the superheated locomotive handled 16.1 per cent more tonnage at an increase of 30.1 per cent higher speed and at the same time showing an economy of 26.8 per cent in coal per thousand ton miles.

In drawing conclusions from the results of the superheater performance, no argument is necessary as convincing evidence has been prominent throughout the comparison of the superheated and non-superheated locomotives, which establishes, beyond a doubt, the marked advantages which may be attributed to the use of superheated steam.

ELECTION OF OFFICERS.

The following officers were elected for the coming year: President, F. F. Gaines, Central of Georgia; first vice-president, E. W. Pratt, Chicago & North Western; second vice-president, Wm. Schlafge, Erie; third vice-president, F. H. Clark, Baltimore & Ohio; treasurer, Dr. Angus Sinclair, and for executive members, C. F. Giles, Louisville & Nashville R. R., and M. K. Barnum, Baltimore & Ohio R. R.

The past president's badge was presented to D. R. MacBain by Robert Quayle.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.

The Railway Supply Mftrs.' Association held its annual meeting at Atlantic City, June 13. The report stated that 82,434 sq. ft. of exhibit space was sold this year against 87,360 ft. last year. Officers for 1914-1915 were unanimously elected as follows: President, J. Will Johnson; vice-president, Oscar F. Ostby. Members of the Executive Committee: Third District, C. E. Postlethwaite and P. J. Mitchell. Fifth District, George H. Porter. Sixth District, Frank E. Beall. Votes of thanks were given the retiring officers for their efficient service. Later the executive committee organized and the president appointed the following committees: Exhibit: Joseph H. Kuhns, chm.; J. C. Whitridge, C. E. Postlethwaite. Finance: F. M. Nellis, chm.; J. C. Currie, C. F. Elliott. Badge: C. B. Yardley, Jr., chm.; Oscar F. Ostby, George H. Porter. Hotel: Oscar F. Ostby, chm.; S. M. Dolan, Phillip J. Mitchell. By-Laws: C. F. Elliott, chm.; F. E. Beall, George H. Porter. Entertainment: George R. Carr, chm. Enrollment: Harold A. Brown, chm. Transportation: George T. Cook, chm. J. D. Conway was re-elected secretary-treasurer.

AUSTIN TRAILING TRUCK.

This truck is designed with a view of improving the action and maintenance of trucks applied as trailing wheels to engines of the Mikado, Pacific or similar types.

To remove the wheels and axles from trucks built with integral boxes, the box must be entirely dismantled and that to remove the box itself for purposes of replacement and repair, the framing structure of the truck must be separated because the box is also a part of the framing. It will be further noted that removal of wheels and axles not only involves the removal of component parts of the truck but frequently of auxiliary pedestal tie bars which exist on false pedestals on the engine frames.

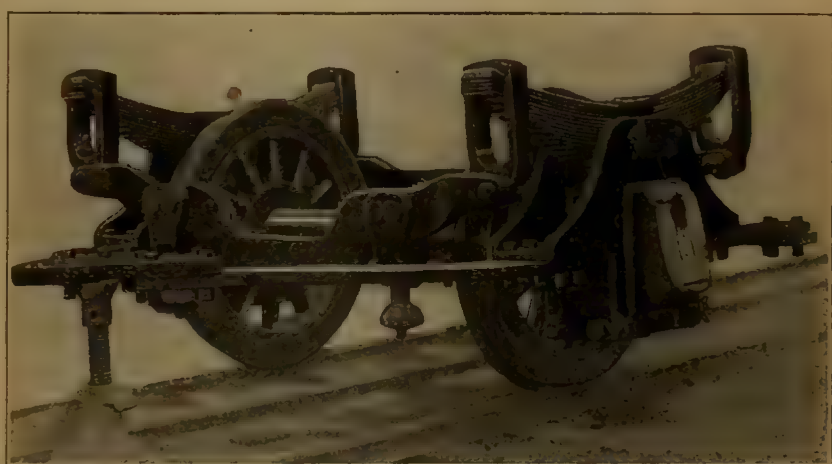
The improved truck shown in the drawing has a separate journal box fitted in a cast steel frame and this box can be removed from the frame without further dismantling the truck. It is merely necessary to remove the pedestal tie at the bottom of the jaw holding the box in the frame, and the boxes, wheels and axles can be dropped or removed by the usual processes of jacking or lifting. The box itself is comparable to a large sized tender box and can be handled in much the same manner. It is of less weight for handling during shipment or in carrying to a machine. The first casting is also of less weight in the foundry. This box is fitted with a spring lid. The brasses fitted to this truck are usually of the "collarless" variety, somewhat similar to a large tender brass and they can be made of any dimensions suitable for the weight carried. Wheels, axles and journal brasses can be made to interchange with those used on any of the other well-known types of trailing trucks.

Some of the points advanced for the improved truck can be explained as follows:

The radius bar is so arranged as to be approximately on the center line with the thrust against the axle and thus greatly improves the strength of the structure. Many radius bars on other trucks are broken because of the low position of this radius frame which passes under the box and which increases by its leverage action the stress due to reaction against the center of the axle.

The improved truck has a strong steel frame rigidly fastened to the radial bars and in nowise dependent on the thimble tie below the frame, this thimble tie having for its sole function the retension of the box in its jaw.

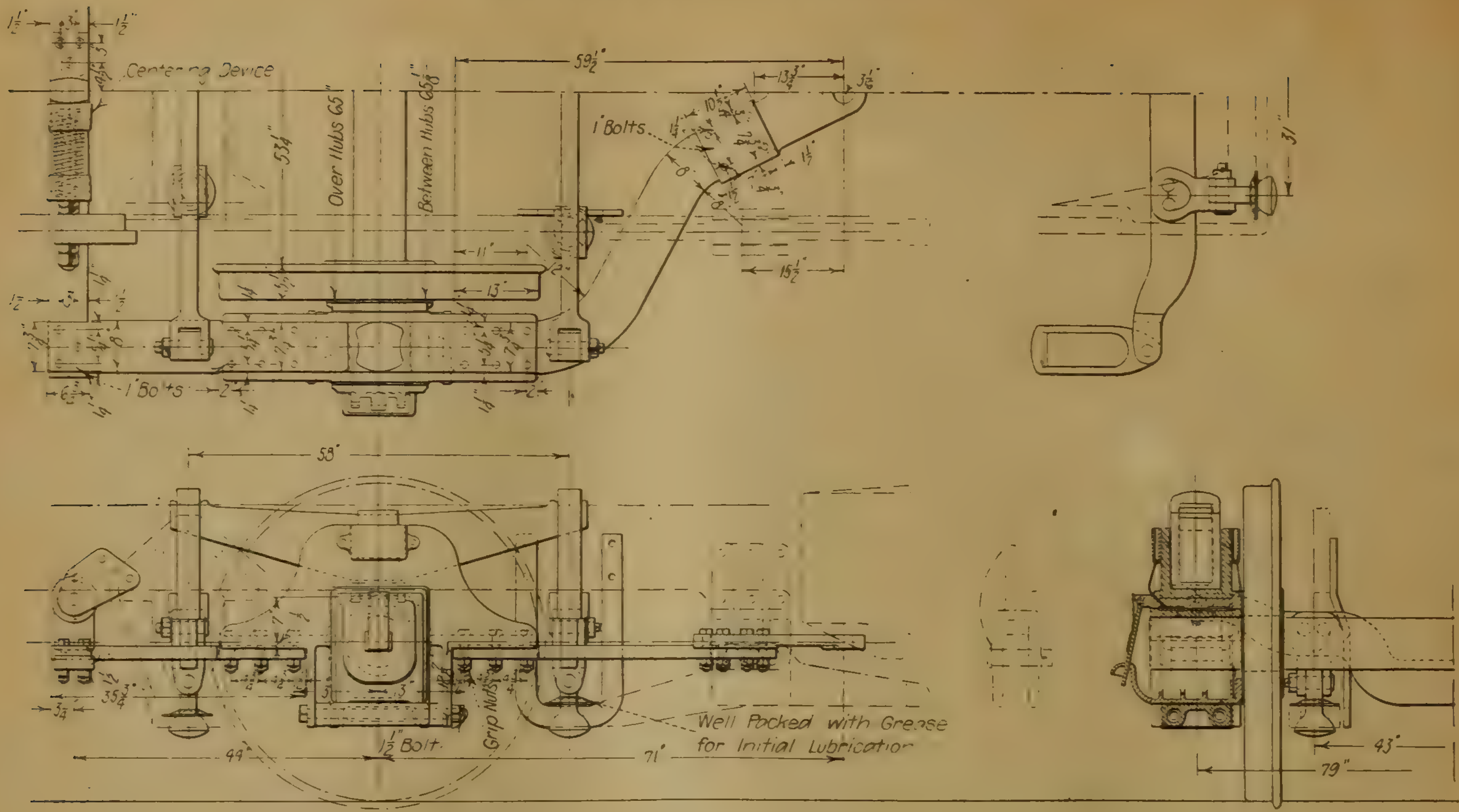
The component frame members of the truck are simple and easily assembled. The frames, right and left, are interchangeable and reversible. The radius bar is made in heavy rectangular section and is well attached to a separate cast steel radial hinge.



Austin Trailing Truck.

The rear end of the framing is composed of two side bars adjoining the cast steel frame and a cross bar connecting transversely. On this bar is mounted a centering device, marked card 440-D-98, but this centering device is unnecessary and can be omitted if desired, the features of the truck being so arranged that "gravity centering" is accomplished through a medium of the heart shaped links which are component parts of the suspension cradles, both front and back of the wheels.

These suspension cradles consist of cross equalizers as illustrated. The rear cradles are attached to the outside spring hangers and in turn suspended from a positive fulcrum by the heart shaped

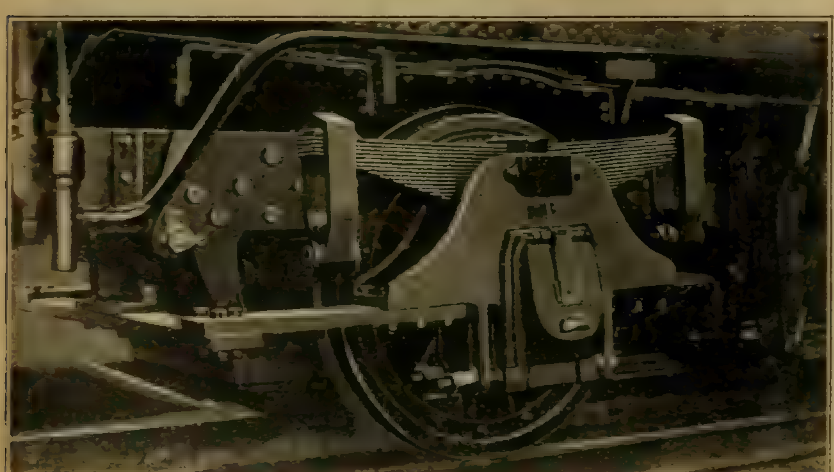


Austin Trailing Truck.

links which are somewhat in the form of universal couplings. The lower portion of these links has a spherical head which allows twisting movements in all directions and also allows the transverse radial motion for the entire cradle.

The first knuckle joint above these spherical ends allows a fore and aft movement so that when the truck radiates the apparent lengthening and shortening of the side members is fully accounted for. The transverse movement of the cradle is governed at the bottom by the spherical head, but at the top by two pins connecting the heart links with the cradle. These pins give a positive bearing while the engine is on a straight track and assure stable equilibrium on account of their three point suspension effect. When transverse movement on the cradle occurs, the heart links radiate from one or the other of their pins according to the direction of movement and always tend to recenter by falling back on the double pins, the condition of the link while raised on one pin being always one of unstable equilibrium. The truck is thus a gravity suspension truck and is similar in its action to any other positive heart shaped link, such action being well demonstrated by front trucks having this type of bolster suspension.

By the employment of the truck described, the rear end of the engine is held in alignment with the drivers by the force of gravity instead of being held by the more or less capricious action of helical centering springs. The cradle on the front of this truck is essentially the same as the one described at the rear, except that



Austin Trailing Truck.

it connects with the driving equalization through the medium of the equalizer located at the back of the rear drivers. This cradle is not restrained by any jaw or contrivance on the frame and is therefore subject to no tendency to nip off outside the frame. Front members of trucks having such contrivances frequently break at this point, due to the restraining action of the frame jaw.

When the truck acts on a curve there is very little angular stress on any one component member of the cradle construction, as transverse flexibility occurs not only at the spherical end of the heart link but also at the top or centering end and again at the outside connection of the cradle to the spring hanger. These trucks have been observed on twenty-three degree curve and their action is remarkable in this particular, the compensating effect of the members of the cradle being particularly noticeable. The angular position of any one member is slight as the component members of the cradle adjust themselves in the manner described.

It will be further noted that this truck is equipped with a journal box oiled in the usual manner by packing placed in the cellar below the axle. It also has an oil cellar located on both the inside and outside frame members, the inner oil cellars serving to oil the hub of the wheel where it bears against the box and the outer cellar serving as an auxiliary oiler for the crown brass. This latter is particularly valuable when breaking in a new journal. The cellar is also fitted with a felt guard.

Attention is called to the engine frame construction used with this truck. It is of the simple slab variety and has no auxiliary pedestal or pedestal binder below the axle which must be removed when assembling the truck. Pedestal binders of this description are found on the bar frames used with some trailing trucks and they serve no useful function except to bind in the structure of the framing itself. Such a trussing or binding effect is not necessary with a slab frame forged from a solid steel billet and practically in line with the pull of the drawbar.

We are indebted to the Lima Locomotive Corporation for the description and illustrations of this truck.

The Missouri, Kansas & Texas has completed surveys for its proposed terminals at San Antonio, Tex. Construction will begin in about two weeks, it is said.

Exhibitors and Exhibits

The members of the Railway Supply Manufacturers' Association who exhibited at Atlantic City this year are as follows:

Acme Machine Tool Company, The, Cincinnati, O.—Cincinnati Acme 3¼x36-inch flat turret lathe; bar work being made to blue print; Cincinnati Acme 18-inch geared head universal turret lathe.

Acme Supply Company, Chicago, Ill.—Acme simplex apex type diaphragm; Acme three-fold sectional diaphragm; Acme diaphragm attachment; Acme vestibule curtain releasing outfit, including revolving shield; steel releasing roller; vestibule curtain hood with fibre insert; Acme and Tuco vestibule curtain handles; weatherproof window; Gem compression curtain fixture; Tuco friction roller; Acme steel vestibule passenger coach doors; steel baggage car side doors; steel baggage car end doors; anti-pinch hinge shields; Kass steel safety step or treads; drawn metal shapes; Chanarch steel car flooring; revolving shade roller box.

Alston Saw & Steel Company, Folcroft, Pa.—Alston new process hack saw blades demonstrated in power hack saw machines.

American Abrasive Metals Company, New York, N. Y.—Feralun safety car steps treads, flooring and other forms of anti-slip treads; Feralun constant service wheel truing brake shoes.

American Arch Company, New York, N. Y.—Reception booth.

American Balance Valve Company, Jersey Shore, Pa.—Valve motion models; full-sized valves which have been in service and models of Jack Wilson high-pressure slide valves and semi-plug piston valve.

American Brake Company, St. Louis, Mo.—Reception booth with the Westinghouse Air Brake Company.

American Brake Shoe & Foundry Company, Mahwah, N. J.—Brake shoes; locomotive driver brake shoes and brake heads; flanged and unflanged passenger coach shoes; unflanged freight car shoes.

American Brass Company, Ansonia, Conn.—Extruded and die-pressed metals, sheet, wire, rod and tubing in non-ferrous alloys, copper commutator and bus bars.

American Car & Foundry Company, New York, N. Y.—Cast iron chilled wheels.

American Car Roof Company, Chicago, Ill.—Model of a car roof.

American Car & Ship Hardware Manufacturing Company, New Castle, Pa.—Babcock safety water gauge protector.

American Flexible Bolt Company, Pittsburgh, Pa.—American staybolts.

American Locomotive Company, New York, N. Y.—Reception booth.

American Mason Safety Tread Company, Boston, Mass.—Mason safety treads, flat and corrugated surface; Empire carborundum treads; Stanwood treads and car steps; Mason non-slip dentil nosing; special flat surface Stanwood tread; Karbolith sanitary fireproof car flooring; Non-slip safety ladder shoes.

American Nut & Bolt Fastener Company, Pittsburgh, Pa.—Bartley nut locks.

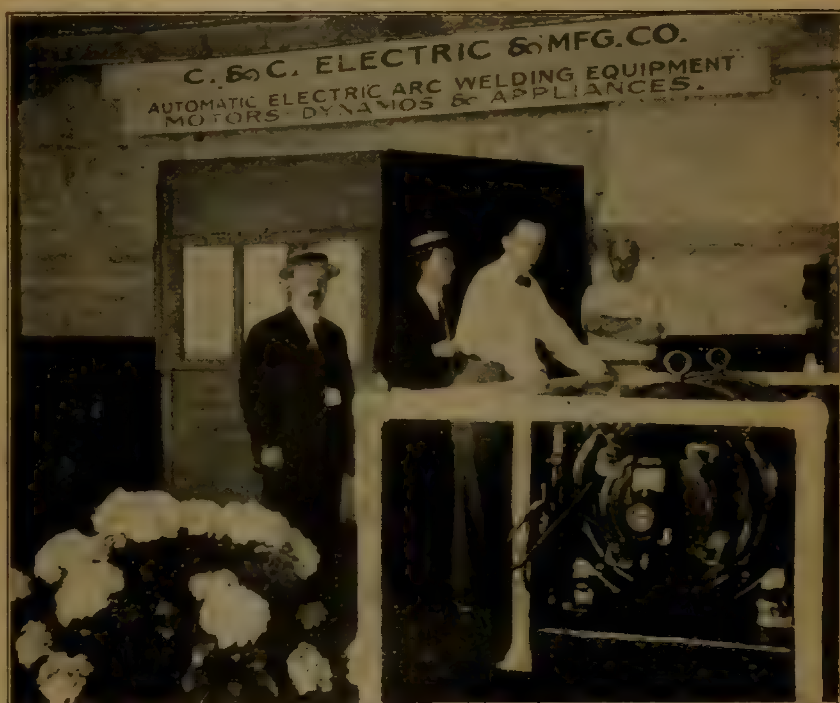
American Roll Gold Leaf Company, Providence, R. I.—Roll gold and aluminum leaf; bronze powder.

American Steam Gage & Valve Manufacturing Company, Boston, Mass.—American hydraulagraph; American trainolog; locomotive pop safety valves; locomotive steam gauges; air brake gauges, and dead weight gauge tester.

American Steel Foundries, Chicago, Ill.—The Vulvan truck; Andrews side frames; cast steel bolsters; Simplex bolsters; Simplex couplers; American coupler pocket; Economy draft arms; Davis cast steel wheels; brake beams; springs; Susemihl roller side bearings; miscellaneous steel castings.

American Tool Works Company, Cincinnati, Ohio.—One 36-inch heavy patterns "American" high duty lathe; one 16-inch high duty tool room lathe; one 6-inch heavy duty radial drill;

The Attractive Quarters of the Westinghouse Companies.



F. A. Saylor, A. M. Bennett, J. E. Chamberlin and G. W. Cravens of the C. & C. Electric & Mfg. Co.

Booths of the Acme Supply Co. and Transportation Utilities Co.

Grip Nut Co. Exhibit. Left to Right: Albert Roberts, W. E. Sharp, H. E. Passmore, Howard Hibbard and E. R. Hibbard.

J. T. Flavin, M. M., C. I. & S. Ry.

F. A. Barbey of the Frictionless Rail.

J. F. Cosgrove, Dean; G. B. Moir, Mgr.; J. R. MacDonald, Mgr., and Ed. M. Sawyer, Mgr., All of the I. C. S.

Jack Wilson, American Balance Valve Co., and B. E. D. Stafford, G. M., Flannery Bolt Co.

John E. Sandmeyer, Wm. Jessop & Co., Inc.

J. G. Haydock, Secretary, E. J. Rooksby & Co.

C. H. Spotts, Sales Mgr. Prince-Groff Co.

Wm. S. Bostwick, Magnus Metal Co.

We Didn't Get the Names of the Handsome Looking Gentlemen.

P. B. Bird and C. A. Bird of the Bird-Archer Co.

Exhibit of the Edison Storage Battery Co.

one 2-inch radial drill; one 24-inch heavy service crank shaper. All motor driven.

Anchor Packing Company, The, Philadelphia, Pa.—Air pump and throttle packing; air pump gaskets.

Armstrong-Blum Manufacturing Company, Chicago, Ill.—Marvel high speed sawing machines.

Armstrong Cork & Insulation Company, Pittsburgh, Pa.—Nonpareil insulating brick; high-pressure covering; boiler lagging; cork car insulation; cork pipe covering for drinking water systems.

Ashton Valve Company, The, Boston, Mass.—Locomotive muffled and open pop safety valves; steam and air gauges; wheel press record gauges; locomotive chime whistles; air brake recording gauges; weight gauge testers; piston swabs; blow-off cocks.

Atlas Automatic Jack Corp., New York, N. Y.—Multi-repeating, instant-lifting jack of any capacity for railroad service.

Baker Brothers, Toledo, Ohio.—Baker high-speed, heavy-duty drill.

Barco Brass & Joint Company, Chicago, Ill.—Barco flexible joints; engine tender steam-heat connections; engine tender air connections; engine tender oil connections; air and steam connections for use between cars; blower line connections; blow-off connections; wash-out hose connections.

Baush Machine Tool Company, Springfield, Mass.—New design Lassiter staybolt turning and threading machine; automatic staybolt drilling machine; new design 5-foot radial drill.

Besly & Company, Chicago, Ill.—Besly pattern makers' disc grinder; motor driven disc grinder; Helmet spiral circles; temper taps; oil; Helmet pressed steel ring wheel chucks.

Bettendorf Company, The, Bettendorf, Iowa.—42-foot, 40-ton, double center sill underframe; 50-foot, 50-ton single center sill underframe; center sill for 40-foot, 30-ton refrigerator car; center sill for 40-foot, 50-ton box car; Bettendorf freight car truck; Bettendorf 70-ton semi-equalized freight truck with variable load brake.

Bird-Archer Company, The, New York, N. Y.—Reception booth; samples of Polarized; also samples of tubes from locomotives that have been treated by same.

Blackall, Robert H., Pittsburgh, Pa.—Rack containing drop handle type Blackall ratchet (operative); flat car type Blackall ratchet; improved Lindstrom brake lever; old style Lindstrom ratchet; rack showing Knox-Harrison one-piece square shaft.

Blake Car Step Works, Inc., The, Charlotte, N. C.—The Blake safety step.

Boker & Co., Hermann, New York, N. Y.—Nickel-clad sheets for car trimmings; Novo high-speed steels; special alloy steels.

Bowser & Co., Inc., S. F., Fort Wayne, Ind.—Gasoline and oil storage systems, consisting of long-distance and first-floor self-measuring pump and storage tanks. Red sentry enclosed long-distance pumps with electric lamp attachment. Complete oil filtration system. Self-registering pipe line measure.

Brown Automatic Hose Coupling Company The, Toledo, Ohio.—Brown automatic hose coupler; Brown open-port air hose coupler.

Browning Company, The, Cleveland, Ohio.—Railway ditchers.

Brubaker & Brothers, W. L., Millersburg, Pa.—Taps; dies, reamers; screw plates; special tools for railroad work.

Buchanan Electric Steel Company, Buchanan, Mich.—Electric furnace castings, consisting of thin-walled and other intricate castings made possible by the use of electric furnaces for melting and refining.

Buckeye Steel Castings Company, The, Columbus, Ohio.—Cast steel car bolsters; truck frames, car trucks; journal boxes; car couplers and coupler yokes.

Buffalo Brake Beam Company, New York, N. Y.—Buffalo freight brake beams for all classes and capacities of equipment, including the new proposed M. C. B. beam, also beams for E. & L. equipment. Beams for all classes and capacities of tenders and electrical equipment for standard, broad and narrow gauge. Buffalo passenger brake beams for all classes of service,

Fred Elliot, Acme Paint Co., and J. M. Crowe, Hubbard & Co.

O. S. Jackson, S. M. P., T. H. & S.-E. Ry.

E. W. Pratt, A. S. M. P., C. & N.-W. Ry.

including P. C. and L. N. equipment with automatically adjustable heads and safety locks.

C. & C. Electric & Manufacturing Company, Garwood, N. J.—Electric arc welding outfit in operation; samples of various kinds of welding done with C. & C. apparatus; panels containing patented system of automatic control; samples of locomotive flue welding.

California Red Wood Association, San Francisco, Cal.—A variety of section of timber showing wear in service.

Camel Company, Chicago, Ill.—Car door fixtures; combination stop and lock and locking arrangement; door locks; door starter; car door hangers; door track; burglar-proof devices for car doors; protection, weather and locking strips; forked angles carlines; burglar-proof bottom door guides; various car door castings.

Carborundum Company, The, Niagara Falls, N. Y.—Carborundum and aloxite.

Carnegie Steel Company, Pittsburgh, Pa.—Steel railway ties; Duquesne joints; Braddock insulated joints; rolled steel locomotive piston head; rolled steel passenger and freight car wheels; rolled steel gear blanks and gears; concrete reinforcement bars; electric and electric alloy steels; screw spikes and track bolts; lantern slide photographs of manufacturing processes.

Cayuta Manufacturing Company, Sayre, Pa.—Ball-bearing screw jacks; brass and aluminum castings; milled screws and worms.

Celfor Tool Company, Buchanan, Mich.—Celfor drills, reamers, flue cutters, countersinks, chucks, sockets, tool holders and tool bits.

Central Electric Company, Chicago, Ill.—Car lighting fixtures; maxolites; car fans; blowers; ralco plugs and receptacles; car appliances; Okonite wires; cables; D. & W. fuses; Columbia Mazda lamps.

Chambers Valve Company, New York, N. Y.—Chambers throttle valve.

Chase & Co., L. C., Boston, Mass.—Railroad car plushes, plain, friezes; Chase imitation leather for Upholstery of smoking-cars and cabooses.

Chicago Car Heating Company, Chicago, Ill.—Vapor system of car heating; car heating specialties; hot-water heating specialties.

Chicago Pneumatic Tool Company, Chicago, Ill.—Chicago Pneumatic air compressors; Little Giant drills; Boyer hammers; Boyer rivet busters; Boyer speed recorders.

Chicago Railway Equipment Company, Chicago, Ill.—Brake beams of the "PC" Creco, "EL" Creco, Diamond special, Diamond, Drexel, Ninety-Six, Monarch and special types; Creco inverted and economy roller side bearings; brake slack adjuster; automatically adjustable brake head; semi-adjustable brake head; removable leg brake head; Creco sliding third point support and safety device; reversible and duplex brake beam struts.

Chicago Varnish Company, Chicago, Ill.—Panels of "Ce Ve" process of painting cars.

Chisholm-Moore Manufacturing Company, The, Cleveland, Ohio.—Cyclone chain hoists from ½ to 40 ton capacity, which are largest single units made; standard screw hoists; matchless trolley, both plain and geared; extended hand wheel shaft hoists; mounted models showing internal workings.

Cincinnati Bickford Tool Company, The, Cincinnati, Ohio.—One 24-inch shaft-driven, high-speed upright drill fitted with patent geared tapping attachment, motor and speed box drive; one 5-inch Cincinnati Bickford plain radial drill fitted with cooling equipment, motor and speed box drive.

Cincinnati Milling Machine Company, The, Cincinnati, Ohio.—High-power, motor-driven miller equipped with stream lubrication; No. 2 high-power vertical miller, motor driven; No. 1½ cutter and tool grinder.

Cincinnati Planer Company, The Cincinnati, Ohio.—One 36x36x8-inch heavy pattern planer, with four heads and reversible motor drive.

Geo. Bourne and R. M. Osterman of the Locomotive Superheater Co.

Robt. H. Weatherly, The Pilliod Co.

Robt. Quayle, G. S. M. P., C. & N.-W. Ry., and Wm. Miller, Pyle-Natl. Elect. Headlight Co.

E. T. Sawyer of the Coml. Acet. Co. and Geo. Ford of the Automatic Ventilator Co.

A. L. Humphrey, Westinghouse Air Brake Co.; F. W. Venton, Crane Co.; W. A. George, Supt. Shops, A., T. & S. F. Ry., Albuquerque, N. M.

Left to Right: Frank D. Fenn, Fred W. Venton, W. LeRoy Ketchum and A. C. Cluppendale.

R. J. Faure, Asst. to V. P., and Chas. E. Lee, V. P. & G. M., Commercial Acetylene Ry. Lt. & Sig. Co.; Willard A. Smith, Railway Review; D. Ahldin, Chf. Engr., Coml. Acet. Ry. Lt. & Sig. Co.

T. P. O'Brian, E. F. Chaffee, Nelson Emmons, F. M. Nicholl and C. H. Rockwell.

Booth of the U. S. Light & Heating Co.

W. E. Wine and C. J. Pilliod, Jr., of the Wine Railway Appliance Company.

H. C. King, Pres., American Mason Safety Tread Co.

E. B. White, H. A. Varney and Wm. White, National Boiler Washing Co.

B. E. D. Stafford, Flannery Bolt Co., and James Keegan, S. M. P., G. R. & I. Ry.

A. H. Burchard of the Durbin Automatic Train Pipe Connector Co.

Robt. Patterson, M. M., Grand Trunk Ry., and Geo. M. Crownover, S. M. P., Chicago Great Western.

R. K. Redding, S. M. P., Penn. R. R., and A. W. Gibbs, Chf. Mech. Engr., Penn. R. R.

W. H. Hall, Chf. Car Insp., C. R. R. of N. J.

Chas. Ducas of the Jacobs-Shupert U. S. Firebox Co.

Miss Z. Alexander, C. E. Rood and William Garstang.

Claude M. Baker of the Murphy Varnish Co.

Prof. Louis E. Endsley, Joe Taylor and Prof. L. W. Wallace.

Philip J. Mitchell and C. E. Postlethwaite, Representatives of Pittsburgh District on General Committee Railway Supply Manufacturers' Association.

Booth of the American Arch Co.

S. W. Simonds, Treas., The Frictionless Rail.

C. A. Seley, American Flexible Bolt Co., and Wife; J. B. Lacey, Treas., N. & W. Ry., and Wife.

Clark Foundry Company, Rumford, Me.—Combined punch and shear.

Coe Manufacturing Company, W. H., Providence, R. I.—Coe's ribbon gold leaf; ribbon aluminum leaf; Coe's gilding wheels.

Commercial Acetylene Railway Light & Signal Company, Inc., New York, N. Y.—Acetylene mantel and open flame lamps; acetylene headlights, classification and cab lamps; acetylene lighted signals with the "AGA" flashlight feature; buoy lantern with acetylene flasher and sun valve; oxy-acetylene welding equipment.

Commonwealth Steel Company, St. Louis, Mo.—Blue prints, photographs, folders and literature concerning cast steel devices which enter into construction of locomotives, passenger and freight cars, representing cast steel engine, tender and trailer trucks; tender frames; pilot and fender bumpers; passenger car bolster; platform end frame and trucks; transom draft gear; end frames; buffing blocks, etc., for freight cars.

Consolidated Car-heating Company, Albany, N. Y.—Latest types of two-piece steam couplers; sectioned quick-opening end valves; packless end valves; sectioned quick-opening admission valves; packless admission valves; single and twin pressure traps; single and twin vapor traps; automatic drain valves; special steam fittings.

Consolidated Railway Electric Lighting & Equipment Company, New York, N. Y.—The "Axle light" equipment under operating conditions, in connection with lead or Edison batteries; new ampere hour battery charge control; type "L" regulators; Timken and ball bearings. The "Clothel" rotary air compressor.

Cooper Hewitt Electric Company, Hoboken, N. J.—Cooper Hewitt electric lamps; quartz lamps; rectifiers for these lamps.

Crane Company, Chicago, Ill.—Locomotive pop safety valves; locomotive blow-off valves; locomotive ash-pan blower valves; locomotive cab hose sprinkler valves; locomotive globe and angle valves; brass to iron seat railroad unions; brass to iron seat railroad union ells and tees; pump stud unions; special tested air brake fittings; steel valves and fittings; Cranetilt steam traps; Crane-Erwood non-return emergency valves; standard malleable and cast iron fittings and full line of valves and fittings for equipping power plants complete.

Crosby Steam Gage & Valve Company, Boston, Mass.—Special appliances for locomotives.

Curtain Supply Company, The, Chicago, Ill.—Window and vestibule curtains; "Ring" curtain fixtures; "Rex" curtain rollers; C. S. Co. and "Rex" diaphragms; diaphragm hoods; "Rex" vestibule curtain outfit; "Rex" opening shields; "Rex" steel rollers; "Rex" vestibule curtain hooks; "Rex" sash balances; "Rex" friction roller curtains; curtain materials.

Dalton Adding Machine Company, Poplar Bluff, Mo.—Adding machines.

Damascus Brake Beam Company, The, Cleveland, Ohio.—High-speed beams for passenger equipment; locomotive tender brake beams; beams for freight equipment; adjustable brake heads; forged steel fulcrums; "Brascott" car ladders; "Damascus" water glass protectors.

Davis Boring Tool Company, St. Louis, Mo.—Car wheel boring tools and a general line of machine shop boring tools and reamers.

Dazie Manufacturing & Supply Company, Inc., New York, N. Y.—Dazie damper and spark arrester; Dazie drive-em-all socket and ferrule; Dazie steam trap; patent railroad journal box; emery wheel guard; saw guard; Simmons auto tire; air valve for air motors.

Dearborn Chemical Company, Chicago, Ill.—Reception booth.

Deforest Sheet & Tinplate Company, Niles, Ohio.—Metal roofing, Lohmannized products, T and T metal posts; T and T culverts.

Detroit Graphite Company, Detroit, Mich.—Specialties in equipment paints.

Detroit Lubricator Company, Detroit, Mich.—Number 22 series of bullseye locomotive lubricators; air cylinder lubricator;

T. J. Lawler, American Roll Gold Leaf Co.

Power Specialty Co.'s Exhibit.
Foster Superheater.

E. Strassburger, E. C. Farlow and T. E. Carliss.

Philip J. Mitchell, Philip S. Justice & Co.

Mrs. B. W. Mudge, Mrs. B. A. Clements and Mrs. W. J. Tollerton.

J. A. McLaughlin, Jr., of Hubbard & Co.

emergency valves; air brake lubricator; boiler valves; electrically operated flange lubricator exhibit complete; improved standard lubricator; "500" air compressor lubricator; sectional force-feed oiler with cut-away tank packless and multiport valves; transfer filler.

Dixon Crucible Company, Joseph, Jersey City, N. J.—Dixon's graphite products, including silica-graphite paint; Ticonderoga flake graphite; graphite greases, giving particular attention to the Dixon graphite brake cylinder grease; boiler graphite; shop supplies, such as belt dressing, pipe joint compound, cup greases, etc., also pencils and crucibles.

Draper Manufacturing Company, The, Port Huron, Mich.—Pneumatic flue welders; pneumatic flue welders for superheater tubes; finishing tools for superheater ball joints; valve facing tools; pneumatic turntable motors.

Dressel Railway Lamp Works, The, New York, N. Y.—Headlights; signal lamps and lanterns.

Duff Manufacturing Company, The, Pittsburgh, Pa.—Genuine Barrett track and automatic lowering jacks; Duff high-speed ball-bearing jack with cyclone lowering device; Duff-Bethlehem forged steel hydraulic jacks; traversing bases; car emergency jacks.

Dupont Fabrikoid Company, Inc., Wilmington, Del.—Fabrikoid material car window curtains, for vestibule curtains, car seat upholstery and cab and caboose cushions.

Eagle Glass & Manufacturing Company, Wellsburg, W. Va.—Steel shop oilers; oil carriers; supply cans; tallow pots; torches; locomotive oilers.

Economy Devices Corporation, New York, N. Y.—Radial buffer; Ragonnet power reverse gear; Casey-Cavin power reverse gear; "Economy" engine truck; Universal valve chest.

Edison Storage Battery Company, Orange, N. J.—Edison storage batteries for train lighting, railway signals, baggage, freight and mail trucks, multiple unit control, electric incandescent headlights, inspection lamps, etc.

Edwards Company, Inc., The O. M., Syracuse, N. Y.—Window fixtures; sash balances; metal extension platform trap doors; all metal shade rollers.

Electric Controller & Manufacturing Company, New York, N. Y.—Lifting magnet handling scrap iron, etc.; automatic machine tool controllers; automatic motor starters with push button control; push button operated wheel lathe controller; reversing motor planer controller; crane controllers.

Electric Storage Battery Company, Philadelphia, Pa.—E. S. B. constant voltage axle system complete with suspension for lighting steam railway passenger cars; low voltage "Hyray-Exide" lighting outfit for small isolated farm and residential plants; above outfits will be in operation. Storage batteries and parts for car lighting, signal, vehicle, automobile starting and lighting service.

Elwell-Parker Electric Company, New York, N. Y.—Electric storage battery industrial, freight and baggage trucks; service recorder.

Equipment Improvement Company, New York, N. Y.—Markel solid main rod end, lateral motion plates, flangeless shoes and wedges and removable driving box brasses; grease plug; Edwards type metallic packing; Wine roller side bearing.

Fastnut, Ltd., London, England.—Fastnut washers, wrenches and file handles.

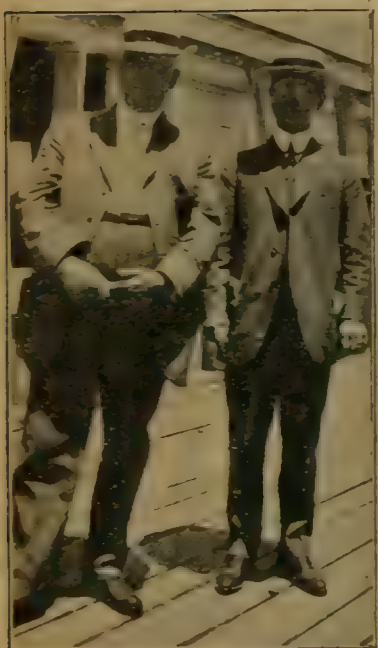
Flannery Bolt Company, Pittsburgh, Pa.—Tate flexible staybolts; installation tools for applying Tate bolts; radial and adjustable crown flexible staybolts; "F. B. C." nut locks for freight cars.

Forged Steel Wheel Company, Pittsburgh, Pa.—Various designs of solid wrought steel wheels for steam and electric railroad service, together with cut-up wheels to demonstrate uniformity of physical properties.

Fort Pitt Malleable Iron Company, Pittsburgh, Pa.—Reception booth.

Foster, The Walter H., New York, N. Y.—Selling agent for

C. S. Myers, Railway List Co., and E. A. Stillman, Watson Stillman Co.



Henry Boutet, Chf. Int. Ins., Cincinnati, and W. R. McMunn, Chf. Clk. Car Dept., N. Y. C. & H. R.

Carter Blatchford, Spencer Otis Co., and B. A. Clements of Worth Bros.

Baush Machine Tool Company, Landis Machine Company and the Landis Tool Company.

Franklin Railway Supply Company, New York, N. Y.—Reception booth.

Frictionless Rail, Boston, Mass.—Rail shapes.

Frost Railway Supply Company, The, Detroit, Mich.—Harvey friction spring gears; Detroit metal weather strip.

Galena-Signal Oil Company, Franklin, Pa.—Reception booth.

Garlock Packing Company, The, Palmyra, N. Y.—Fibrous and metal packings; special air pump and throttle packings, gaskets, valves and sheet packings.

General Brake Shoe & Supply Company, Chicago, Ill.—Armbrust driver, traction, passenger and freight car brake shoes; Armbrust interlocking brake shoe.

General Electric Company, Schenectady, N. Y.—Reception booth.

Gold Car Heating & Lighting Company, New York, N. Y.—Car heating systems; combination pressure and vapor; straight steam; hot water refrigerator storage; electric heaters; thermostatic control for steam, hot water and electric systems. Pressure regulator; temperature regulators, twin supply valves; steam hose couplers; ventilators; curtain window ventilators; journal boxes, and lids; dust guards.

Goldschmidt Thermit Company, New York, N. Y.—Samples of Thermit welds including a large weld on a 9¼-inch 2 throw crank shaft for refrigerating machine. Materials and apparatus used in locomotive shops for Thermit welding; such as preheaters, crucibles, mold box, special mixtures of Thermit, etc. Samples of metals free from carbon and numerous photographs and transparencies of Thermit welding operations.

Gould Coupler Company, New York, N. Y.—Gould simplex system electric car lighting; storage batteries; cast steel locomotive end sill with friction draft gear incorporated; cast steel jaw type side frame; cast steel buffer for express refrigerator cars; cast steel passenger couplers; cast steel "Z" type freight couplers, top and bottom unlock; malleable iron freight and passenger journal boxes; friction draft gear.

Gould Storage Battery Company, New York, N. Y.—Gould simplex system electric car lighting.

Greene, Tweed & Company, New York, N. Y.—Palmetto, round and square, braided packing; Palmetto twist packing for small valves; packing in sets for air pumps and throttles. Manhattan packing for hydraulic pressures; Favorite reversible ratchet wrench.

Griffin Wheel Company, Chicago, Ill.—Chilled car wheels on standards.

Grip Nut Company, Chicago, Ill.—Grip nuts.

Hale and Kilburn Company, Philadelphia, Pa.—Steel passenger car interior finish; steel dining car interior finish; steel passenger car doors; steel baggage and mail car doors; steel mail car letter cases; integral window construction for steel cars; all-steel walkover seats as used by the principal railway systems; parlor car chairs and reclining chairs for chair cars.

Hammett, H. G., Troy, N. Y.—Trojan metallic packing; Trojan bell ringers; samples of injector unions attached to copper pipe by expanding and beading.

Harrington, Son & Company, Inc., Edwin, Philadelphia, Pa.—Multiple spindle drill; overhead tramway; travelers; peerless—screw and differential hoists.

Hartshorn Company, Stewart, East Newark, N. J.—Car curtain spring rollers; vestibule rollers; spring sash lifts and brackets suitable for all classes of fittings.

Harvey's Sons Manufacturing Company, Ltd., A., Detroit, Mich.—The Harvey-Wright pipe wrench.

Heppenstall Forge & Knife Company, Pittsburgh, Pa.—Heat-treated specimens of steel forgings, die blocks and shear knives.

Hewitt, H. H., New York, N. Y.—Articulated car truck, full size; articulated tender truck, full size; one car mounted on articulated trucks, suspension carriers, quarter-size; one six-wheel engine tender truck, quarter-size.

George Sargent, Sargent & Co.

E. H. Hinchens, S. S., B. & O. R. R.

Charles Fuller, S. M. P., Union Pacific R. R.

W. S. Bartholomew, Locomotive Stoker Co.

T. E. Carliss and S. A. Crone of the Buffalo Brake Beam Co.

Representatives Pressed Steel Car Co. Upper Row: W. H. Wilkinson, C. A. Lindstrom. Lower Row: C. E. Postlethwaite, J. H. Mitchell, L. C. Cameron.

L. Fitch, West. Mall. Iron Co.; L. A. Hoerr, Pres., West. Ry. Equip. Co., and S. Campbell, Railway Devices Co.

Egbert H. Gold, Harry F. Lowran and Jos. E. Buker of the Chicago Car Heating Co.

Col. J. M. High, Pantosote Co., and C. E. Chambers, S. M. P., C. R. R. of N. J.

Prince-Groff Co., C. H. Spotts at the Desk.

Arthur Hollingshead, E. B. White, Wm. White and L. F. Wilson.

Wm. H. Lutz and Samuel Mason.

Hewitt Rubber Company, New York, N. Y.—Air brake hose; corrugated tank hose; steam heat hose; water hose; inlaid tiling; knob and corrugated matting; rubber belting.

Heywood Brothers and Wakefield Company, Wakefield, Mass.—Railway car seats.

Hollands Manufacturing Company, Erie, Pa.—Machinists' solid jaw vises; machinists' swivel jaw vises; combination pipe vises; malleable hinged pipe vises; Hollands pipe cutters; pipe threating stocks and dies.

Hubbard & Company, Pittsburgh, Pa.—Hunt cross-thread nut locks; hot pressed nuts; cold punched nuts, and H. M. slotted nuts; track bolts; rivets and semi-finished nuts; track adzes; track tools, etc.

Hunt Spiller Manufacturing Corporation, South Boston, Mass.—Cylinder bushings; cylinder packing; piston heads; valve bushings; valve packing; valve bull rings; crosshead shoes; shoes and wedges; driving boxes; rod bushings; knuckle pin bushings; crown bearings; air pump bushings; air pump packing; eccentrics and straps.

Hutchins Car Roofing Company, Detroit, Mich.—Hutchins Camber all steel roof on Canadian Pacific car on exhibit tracks foot Mississippi Ave.

Illinois Steel Company, Chicago, Ill.—Railroad track bolts and nuts; plain spikes and screw spikes; electric carbon and electric alloy sample steels and specimen tests; transparency views of operations in the manufacture of car, engine and interurban forged steel axles.

Imperial Car Cleaner Company, Newark, N. J.—A portable machine and chemical process in practical operation for cleaning and restoring plush cushions of passenger coaches at terminal yards.

Independent Pneumatic Tool Company, Chicago, Ill.—Thor piston air drills for drilling, reaming, tapping, flue-rolling and wood boring; corner drills for use in close quarters; pneumatic riveting, chipping, calking and flue-beading hammers; pneumatic stayboldt drivers; Thor pneumatic grinders; Thor electric drills.

Ingersoll-Rand Company, New York, N. Y.—Pneumatic tools, consisting of "Little David" roller and ball bearing piston air drills, for drilling, reaming, tapping and flue rolling; riveting hammers for driving rivets up to 1¼ inches; chipping hammers for all classes of chipping, calking, scaling, flue beading; Imperial air motor hoists—capacity up to 10 tons; Little David jam riveters; Crown holder-ons and Crown bench and floor sand rammers.

International Oxygen Company, New York, N. Y.—The I. O. C. system in operation.

Jacobs-Shupert U. S. Firebox Company, Coatesville, Pa.—Firebox sections; flanged parts; photographs and drawings.

Jenkins Bros., New York, N. Y.—Railway globe angle cross and Y brass valves; special round house valves; steel, iron and brass gate valves; packing, tubing and mechanical rubber specialties.

Johns-Manville Company, H. W., New York, N. Y.—Asbestos and magnesia material; asbestos cements; pipe coverings; boiler lagging; packings, roofings, waterproofing; mastic flooring; J.-M. expander rings; transite and ebony asbestos wood; asbestos shingles; transite asbestos smoke jacks; steel pasenger car insulation; refrigerator car insulation; fiber and sectional conduit; electrical materials; J.-M. automatic car seal; flexible armored hose; Jones speedometers for locomotives and passenger cars; cork tilings; linolite lighting.

Joliet Railway Supply Company, Chicago, Ill.—Brake beams; side bearings; center plates.

Jones & Lamson Machine Company, Springfield, Vt.—One 2 x 24 flat turret lathe; double spindle flat turret lathe; Hartness automatic dies.

Jones & Laughlin Steel Company, Pittsburgh, Pa.—Steel sheet piling and tie plates.

Joyce-Cridland Company, The—Railroad jacks.

W. E. Wine of the Wine Railway Appliance Co.

H. W. Belnap, Chf. Ins. Safety App., Interstate Commerce Commission; F. W. Brazier, Supt. Car Dept., N. Y. C. & H. R.; Jas. O'Gilvie, Mech. Exp., Canadian Board of Railway Commissioners.

Booth of the Bird-Archer Co.

Left to Right: C. A. Bird, Ins. Engr.; C. J. McGurn, Ins. Engr.; Fred O. Paige, V. P.; G. H. Fitzgerald, Mgr. Pittsburgh Office; P. B. Bird, Pres. and G. M.; H. V. Bootes, Secy.; W. E. Ridenour, Chf. Chem., and John Barnes, Chf. Chem. Exp.

Geo. N. Riley of the National Tube Co.

C. C. Young and Frank Trump, Am. Balance Valve Co.

Left to Right: W. E. Kelly, Patton Paint Co.; Arthur N. Dugan, Bronze Metal Co.; Walter Coyle, Franklin Ry. Supply Co.; Geo. H. Porter, Western Electric Co.; F. A. Buckley, Central Ry. Signal Co.; P. J. Shaughnessy, Erie R. R.; J. M. Shaw, D. L. & W. R. R., and T. F. Barton, D. L. & W. R. R. Photo at Mt. Vernon, Va.

Booth of the Reed Mfg. Co.

Justice & Company, Philip S., Philadelphia, Pa.—Reliance hydraulic jacks; wheel base and journal patterns.

Kelley Railway Appliance Company, Gradyville, Ga.—Car couplers and car replacers.

Kerite Insulated Wires & Cables Co., The, New York, N. Y.—Kerite insulated wires and cables.

Keyoke Railway Equipment Company, Chicago, Ill.—Murray cast steel friction draft gear; Murray cast steel coupler yoke; Acme hand brake ratchet; Safety air brake pin.

Keystone Lubricating Company, Philadelphia, Pa.—Keystone driving box.

Landis Machine Company, Waynesboro, Pa.—One 2-inch double head motor driven bolt cutter; one 1½-inch single head bolt cutter; one 8-inch pipe die head; one 2-inch pipe die head; one ½-inch automatic screw cutting die head; one 1¼-inch automatic screw cutting die head; one ½-inch solid adjustable die head; one 1-inch solid adjustable die head.

Landis Tool Company, Waynesboro, Pa.—Self-contained plain grinder.

Lawrence & Company, B. F., Buffalo, N. Y.—Combined snow flanger and ballast spreader.

LeBlond Machine Tool Company, The R. K., Cincinnati, O.—One 25-inch x 10-foot motor driven heavy duty engine lathe with 20 horsepower motor; number 3 heavy duty plain milling machine motor driven with rapid power transverse to table; 21-inch x 10-foot quick change engine lathe with 3-step cone and double friction back gears; number 1 universal cutter and tool room grinder; 16-inch x 6-foot portable fitting lathe; various parts of machines showing details of constructions.

Lehon Company, The, Chicago, Ill.—Roofing for railroad buildings; plastic car roofing; insulating paper; waterproofed canvas for passenger coach, cab and caboose roofs; saturated burlap for waterproofing concrete construction work; paint for waterproofing, roofing and metal work.

Liberty Manufacturing Company, Pittsburgh, Pa.—Cleaners for locomotive arch tubes.

Locomotive Arch Brick Company, Chicago, Ill.—Model of fire box showing installation of Economy sectional arch. Also samples of fire brick of the Economy design.

Locomotive Stoker Company, Schenectady, N. Y.—One type "C" Street locomotive stoker. Samples of coal handled by the Street locomotive stoker.

Locomotive Superheater Company, New York, N. Y.—Electric pyrometer for indicating the temperatures of superheated system; latest design of superheater unit; soft metal grinding process mold.

Lodge & Shipley Machine Tool Company, The, Cincinnati, Ohio.—One 16-inch x 6-foot selective head universal tool room lathe; one 18-inch x 8-foot selective head manufacturing engine lathe; one 30-inch x 14-foot heavy forge lathe; one 48-inch x 14-foot selective head engine lathe.

Long, Jr., Company, Charles R., Louisville, Ky.—General line of railway paints.

Lunkenheimer Company, The, Cincinnati, Ohio.—Valves; oil and grease cups; lubricators; oil pumps; injectors; whistles; cocks and other engineering specialties.

Lutz-Webster Engineering Company, Inc., Philadelphia, Pa.—Lutz universal compression wrench; compression ratchet; no-set-screw lathe dog; self-feeding, self-centering "old man;" drill, tap and reamer holder for machine work; one-piece friction ratchet; tap, reamer and stud wrench.

MacRae's Blue Book Company, Chicago, Ill.—MacRae's Blue Book; The Railway Supply Index-Catalogue.

McConway & Torley Company, The, Pittsburgh, Pa.—Various designs of M. C. B. couplers for freight and passenger service and for locomotives.

McCord & Company, Chicago, Ill.—Steel and malleable iron journal boxes; force feed locomotive lubricators.

McCord Manufacturing Company, Detroit, Mich.—Universal window fixtures; sash balances; deck sash ratchets; hose protectors; McKim gaskets.

McGraw Publishing Company, Inc., New York, N. Y.—Reception space, exhibiting copies of *Electric Railway Journal, Engineering Record, Electrical World, Metallurgical and Chemical Engineering, McGraw Electric Railway Manual*, and *Electric Railway Dictionary*.

Magnus Metal Company, New York, N. Y.—Magnus metal journal bearings; engine driver brasses; rod brasses and Magnus metal in ingots.

Mahr Manufacturing Company, Minneapolis, Minn.—Mahr No. 1-C portable torch for steel car repairing; No. 2 portable torch for boiler and machine shop work; Nos. 3 and 4 portable torches, special; No. 5 portable torch for paint burning.

Manning, Maxwell & Moore, Inc., New York, N. Y.—Reception booth.

Mark Manufacturing Company, Chicago, Ill.—Mark cold drawn steel unions.

Massachusetts Mohair Plush Company, Boston, Mass.—Railway car seat and Mohair plushes.

Midvale Steel Company, The, Nicetown, Philadelphia, Pa.—Rolled steel wheels; steel tired wheels; axles.

Monarch Steel Castings Company, Detroit, Mich.—Lion locomotive couplers; Lion freight car couplers; Monarch locomotive pocket castings.

Mudge & Company, Chicago, Ill.—Mudge-Slater spark arrester; Mudge-Peerless car ventilators.

Nathan Manufacturing Company, New York, N. Y.—Injectors; lubricators; boiler checks; gage cocks; coal sprinkler; steam valve; mechanical lubricators; low water alarms; safety valves; water gauges; fire extinguishers; boiler washers and testers.

National Car Wheel Company, Pittsburgh, Pa.—Cast iron wheels.

National Graphite Lubricator Company, The, Scranton, Pa.—Locomotive graphite lubricators; stationary engine graphite lubricators; automobile type graphite lubricators; turbine type lubricators for locomotive.

National Lock Washer Company, The, Newark, N. J.—Car curtains; curtain and window fixtures; lock washers.

National Malleable Castings Company, The, Cleveland, Ohio.—Couplers; journal boxes; brake staff mechanism; malleable iron castings.

National Tube Company, Pittsburgh, Pa.—Reception booth.

Newhall Engineering Company, George M., Philadelphia, Pa.—Photographs of Industrial Works wrecking cranes, locomotive cranes and pile drivers; photographs of Winters boiler wash-out system; photographs of Peterson heat treatment furnaces.

Newton Machine Tool Works, Inc., Philadelphia, Pa.—Locomotive radius-link grinding machine; cold metal sawing machine.

New York Air Brake Company, The, New York, N. Y.—Reception booth.

Niles-Bement-Pond Company, New York, N. Y.—Niles combined journal turning and axle turning lathe; Pratt & Whitney side-head boring mill; Pratt & Whitney 10-inch vertical shaper.

Norton, Inc., A. O., Boston, Mass.—Lifting jacks.

Nuttall Company, R. D., Pittsburgh, Pa.—Electric locomotive gears and pinions; current collecting devices; railroad machine shop gears and pinions; practical demonstration of heat treatment of steels as applied to electric locomotive gears and pinions.

Nuway Packing Guard Company, Tuscaloosa, Ala.—Nuway journal box packing guard.

Okonite Company, The, New York, N. Y.—Insulated wires and cables.

O'Malley-Beare Valve Company, Chicago, Ill.—Multiplate system of valves; globe, angle, check, locomotive stop valves; duplex-blow-out valves.

Pantasote Company, The, New York, N. Y.—Pantasote curtain and upholstery material; Agasote material—for ceilings, wainscoting and interior trim.

Parkesburg Iron Company, The, Parkesburg, Pa.—Charcoal

C. A. Methfessal, E. A. Johnson, G. E. Watts and I. E. Hindman of the Duff Mfg. Co.

Commercial Acetylene Booth.

The Judge and the General.

A. M. Darlow, S. M. P., Buffalo & Susq. R. R.; Gertrude Patterson; Robt. Patterson, M. M., Grand Trunk; Mrs. E. R. Darlow, Mrs. J. Markey and J. Markey, M. M., Grand Trunk.

P. W. Miller and Maj. Azel Ames, Kerite Insulated Wire & Cable Company.

W. J. Clark of the General Electric Co., and Mrs. Clark.

iron boiler tubes; safe ends; arch tubes and locomotive superheater tubes.

Peakes & Hamlin, Milo, Maine.—Automatic freight car-door lock; door run.

Pels & Company, Henry, New York, N. Y.—Punching and shearing machines.

Pilliod Company, The, New York, N. Y.—Baker locomotive valve gear; full size model on a miniature locomotive.

Pocket List of Railroad Officials, New York, N. Y.—Copies of publication.

Pollak Steel Company, The, Cincinnati, Ohio.—Special heat treated and oil tempered solid and hollow bored axles for locomotives, cars, freight and passenger; crank pins, piston rods, side rods, connecting rods.

Potter Manufacturing Company, W. M., The, Philadelphia, Pa.—Improved safety coupler and draft rigging for steam and electric cars and engines.

Power Specialty Company, New York, N. Y.—Full size model of Foster locomotive superheater.

Pressed Steel Car Company, New York, N. Y.—Photographs of products.

Prince-Groff Company, New York, N. Y.—"Pressurlokd" water gage systems; "Wedglok" track drilling system; "Kwik-grip" pipe wrenches.

Pyle-National Electric Headlight Company, Chicago, Ill.—Locomotive electric headlight set and headlight case; type "E" turbo-generating set (arc headlight set) type "S" turbo-generating incandescent headlight set.

Pyrene Manufacturing Company, New York, N. Y.—Pyrene fire extinguisher.

Quigley Furnace & Foundry Company, New York, N. Y.—Powdered coal equipment; continuous core oven; photographic display of furnaces and equipment.

Railway Devices Company, St. Louis, Mo.—"Perfect" drop brake handle; "Interlox" brake mast ratchet and pawl; the iron horse or pedestal; "Spiral" pipe clamps.

Railway Electrical Engineer, Chicago, Ill.—Copies of the *Railway Electrical Engineer.*

Railway List Company, The, Chicago, Ill.—Copies of the *Railway Master Mechanic; Monthly Official Railway List; Railway Engineering and Maintenance of Way.*

Railway Materials Company, The, Chicago, Ill.—Steel back brake shoes; Ferguson shop furnaces; blue prints.

Railway Review, Chicago, Ill.—Copies of the *Railway Review.*

Railway Utility Company, Chicago, Ill.—Utility honeycomb car ventilators for monitor deck and for arch roof cars; thermometer steam heat regulator; thermometer electric heat regulator; automatic freight car door locks; electric vacuum car cleaners.

Ralston Steel Car Company, The, Columbus, Ohio.—One Ralston flush floor, drop bottom general service car.

Reading Specialties Company, Reading, Pa.—Rerailers; guard rail clamps; step joints; derail; miscellaneous steel castings.

Reed Manufacturing Company, Erie, Pa.—Machinists' vises; pipe stock and dies; pie cutters; pipe vises.

Reliance Electric & Engineering Company, Cleveland, Ohio.—Motors for the individual drive of machine tools, both D. C. adjustable speed and constant speed and A. C. constant speed.

Remy Electric Company, Anderson, Ind.—American electric headlight complete.

Robinson Company, The, Boston, Mass.—Robinson exhaust nozzle; rail anchor; air strainer; Morton vacuum breaker.

Rochester Germicide Company, Rochester, N. Y.—Disinfectants and sanitary appliances; paper towels; drinking fountains; liquid soap and dispensers; sweeping compounds.

Rooksby & Company, E. J., Philadelphia, Pa.—Portable boring bars for reboring locomotive cylinders and valve seats.

Ross-Schofield Company, New York, N. Y.—Working model of Ross-Schofield system on locomotive and Scotch marine boilers; pattern of locomotive firebox illustrating the system.

S. W. Swallow and E. J. Arlein, W. H. Coe Mfg. Co.

Top Row, Left to Right: J. M. Monroe, A. B. Root, Jr., V. W. Ellet, E. J. Fuller. Lower Row: J. G. Platt, W. B. Leach, Frederic Parker. All in the uniform of the Hunt-Spiller Mfg. Co.

H. M. Perry, at the Left, With Dr. J. M. Griffin of the Wheel Truing Brake Shoe Co.

Rubberset Company, Newark, N. J.—Brushes for painting, varnishing, and kalsomining.

Ryan, Galloway & Company, Chicago, Ill.—Reciprocating coal passer for locomotive tenders; slack adjusting draw bar for use between engine and tender; non-clogging sand pipe.

Ryerson & Son, Joseph T., Chicago, Ill.—Ulster special staybolt iron; Ulster enginebolt iron; diamond B chisel steel; Nikrome steel for piston rods; crank pins; axles; motion parts; Sweeley adjustable boring bars; Ryerson high speed twist drill.

Safety Car Heating & Lighting Company, New York, N. Y.—Pintsch mantle lighting equipment; Safety electric car lighting equipment; gas and electric lighting fixtures; oxy-Pintsch metal cutting and welding apparatus; electric fans.

Safety First Manufacturing Company, Chicago, Ill.—Flaxlinum insulation for refrigerator cars, steel passenger cars, etc.; safety parcel rack for passenger cars; perfection door guide and seal; safety angle cock bracket; automatic flue welding machine; Watters' locomotive sander.

Sargent Company, Chicago, Ill.—Sargent gage; Ironclad water glass protector; "E. S. E." water glass cocks; "E. S. E." reflex gage; "E. S. E." blow-off valve; Loedige quick acting blower valve; Lenz safety lathe dog; Sargent safety valve; Reading steel casting specialties; Moncrieff's tubular glasses.

Scullin-Gallagher Iron & Steel Company, St. Louis, Mo.—Freight car truck equipped with Scullin truck side frames.

Sellers & Company, Inc., Wm., Philadelphia, Pa.—One 54-inch car wheel boring machine, with automatic chuck, pneumatic hoist, and boring bars; power transmission details; locomotive injector and valve details; steel-bronze nuts.

Simmons-Boardman Publishing Company, New York, N. Y.—Copies of the *Railway Age Gazette; Railway Age Gazette, Mechanical Edition; Signal Engineer.*

Standard Asphalt & Rubber Company, Chicago, Ill.—Sarco mineral rubber floors; pipe coating; permanent waterproofing; insulating material; coatings; car seal; bituminous putty.

Standard Coupler Company, New York, N. Y.—Sessions-Standard friction draft gear type "K."

Standard Heat and Ventilation Company, Inc., New York, N. Y.—Improved car heating apparatus of all kinds. Latest systems of passenger car ventilation. Steam hose couplers; end train line valves; automatic traps and regulators.

Standard Steel Car Company, Pittsburgh, Pa.—Reception booth.

Standard Stoker Company, Inc., New York, N. Y.—Standard stoker.

Strong, Carlisle & Hammond Company, The, Cleveland, Ohio.—Randall graphite sheet lubricator.

Swift & Sons, M., Hartford, Conn.—Gold leaf rolls; aluminum leaf rolls; gold and aluminum leaf in books.

Symington Company, The T. H., Rochester, N. Y.—Symington journal boxes; Farlow draft gear; Symington side bearings.

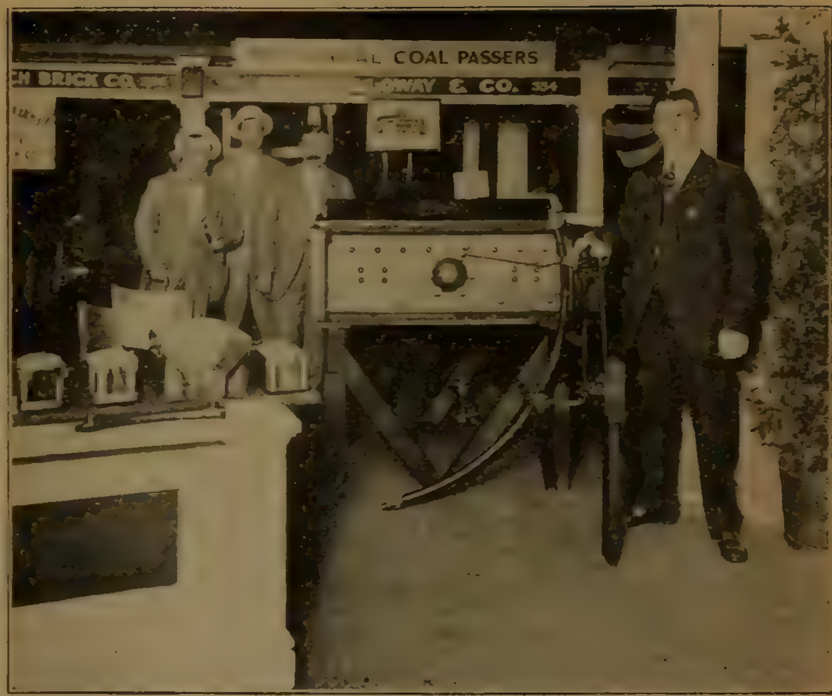
Transportation Utilities Company, New York, N. Y.—Flexolith composition flooring; Resisto insulation; National steel trap doors; National standard roofing; steel sheathing; Imperial window screens; Eclipse deck sash ratchets; Perfection and Reliance sash balances; steel car doors; Titanlite steel freight car door; B-J journal box cooler; Brown weatherstrips; Tuco window curtains; Acme vestibule curtains and shields; Acme vestibule diaphragm; Acme weatherproof window fixtures; Chanarch steel flooring; Acme anti-pinch shields; Acme deck sash.

Union Draft Gear Company, Chicago, Ill.—Cardwell friction draft gear and Cardwell rocker side bearings.

Union Railway Equipment Company, Chicago, Ill.—Pries metal car roofs; Union drop brake shaft; Pries refrigerator radiator; Union pressed steel carlines; Pries brine tank valves.

Union Spring and Manufacturing Company, Pittsburgh, Pa.—Railroad springs, every description; Kensington journal boxes (all steel); steel castings; pressed steel shapes.

United Engineering & Foundry Company, Pittsburgh, Pa.—Photographs of high speed steam hydraulic forging presses.



Ryan, Galloway & Co.

Arthur Allan and J. Will Johnson.

H. E. Passmore, Grip Nut Co.; Robt. Patterson, Grand Trunk; W. E. Sharp, Grip Nut Co., and G. M. Crownover, Chicago Great Western R. R.

U. S. Light & Heating Company, The, Niagara Falls, N. Y.—The U. S. L. Electric Lighting Equipment for railroad cars in operation; electric regulating panels; electric generators; storage batteries of all types; electric starter for gasoline engines.

U. S. Metal and Manufacturing Company, New York, N. Y.—Cayuta ball bearing jacks; collapsible stake pocket; "Texoderm" seat upholstering; multiple unit puttyless skylight.

United States Metallic Packing Company, The, Philadelphia, Pa.—King packing; Leach sanders; Gollmar bell ringer.

Universal Car Seal & Appliance Co., Albany, N. Y.—Car door fasteners.

Universal Draft Gear Attachment Company, Chicago, Ill.—Full sized model cast steel draft arms; full sized model twin spring draft gear with key connected coupler; keyed yokes for friction draft gear; keyed yokes for tandem draft gear; lock yokes for friction draft gear; one-piece cast steel riveted type of yokes for friction draft gear; miscellaneous malleable iron, also cast steel draft plates and lugs.

Valentine & Company, New York, N. Y.—Valspar; panels showing various systems of painting wood and steel railway equipment; railway signal enamels.

Van Dorn Girder Plate Company, Chicago, Ill.—One-piece steel end and sectional two-piece steel end.

Vissering & Company, Harry, Chicago, Ill.—Viloco and Leach type sanders; Viloco one-piece brake step; Viloco bell-ringer; Crescent metallic packing.

Vulcan Process Company, Minneapolis, Minn.—One complete Number 4 Vulcan oxy-acetylene welding and cutting apparatus with 50-pound acetylene generator, mounted on truck, and one Number 2 truck mounted portable welding and cutting unit having compressed gases.

Warner & Swasey Company, The, Cleveland, Ohio.—One Number 2A universal hollow hexagon turret lathe, capacity 2¼ inches x 26 inches, 15½-inch swing, completely tooled for producing knuckle pins driven by the General Electric motor; one 3A universal hollow hexagon turret lathe, completely tooled for the production of piston valve followers driven by Westinghouse Electric motor.

Watson-Stillman Company, The, Aldene, N. J.—Section of hydraulic jack; one or two styles of jacks used mostly in railroad service; blueprints and photographs showing hydraulic tools and machinery used by railroads.

West Coast Lumber Manufacturers' Association, Tacoma, Wash.—Douglas fir lumber; car siding clears; lining clears; sills and framing; sections of logs and timbers; flitches; clear finished panels; section of an 8-inch x 16-inch bridge stringer 28 years old; clears in horizontal box car sheathing; factory and machine crating lumber; clears in spruce and cedar.

West Disinfecting Company, New York, N. Y.—Liquid soap dispensers and liquid soap; automatic deodorizing machines; sanitor closets; steam sterilizers, etc.

Western Railway Equipment Company, St. Louis, Mo.—Acme automatic brake slack adjuster; Linstrom locomotive syphon; Western brake jaws; Security dust guards; Western steel carlines.

Western Steel Car & Foundry Company, New York, N. Y.—Reception booth.

Westinghouse Air Brake Company, Pittsburgh, Pa.—Reception booth.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—Reception booth with the Westinghouse companies and arc welding exhibit in operation on the pier end.

Westinghouse Lamp Company, Pittsburgh, Pa.—Lamps used in lighting the booth on the pier.

Westinghouse Machine Company, The, East Pittsburgh, Pa.—Reception booth.

Westinghouse Traction Brake Company, Pittsburgh, Pa.—Reception booth with Westinghouse Air Brake Company.

Wheel Truing Brake Shoe Company, Detroit, Mich.—Abrasive brake shoes.

White Enamel Refrigerator Company, St. Paul, Minn.—Bohn collapsible bulkhead; house refrigerator showing the Bohn syphon system; method of flax fiber car insulation.

Wickes Boiler Company, The, Saginaw, Mich.—Working model of the Wickes vertical water-tube boiler.

Wiener Machinery Company, New York, N. Y.—One Oeking solid steel quadruple combination punch, shear and double bar and angle cutter; two styles of universal radial drills.

Wiley & Russell Manufacturing Company, Greenfield, Mass.—Specials machine screw taps; stay bolt taps; boiler taps; patch bolt taps; bridge reamers; general line of taps, dies and screw cutting tools and machinery.

Willson & Company, Inc., T. A., Reading, Pa.—Safety glasses for every requirement; Albex eye protectors; Willson safety glasses and the new Willson goggle.

Wilmarth & Morman Company, Grand Rapids, Mich.,—New Yankee drill grinders; combination water tool and drill grinders; combination cutter, reamer and drill grinders; surface grinders.

Wilson Remover Company, Newark, N. J.— Paint and Varnish remover; mechanical appliances and cushion cleaning machine for railway terminals.

Wiltbonco Manufacturing Company, Boston, Mass.—Reflex water gages; safety coal sprinklers; water gage cocks; water gage fittings.

Wine Railway Appliance Company, The, Toledo, Ohio.—Wine steel ladder; metal ventilator for fruit cars; grab iron filler; ash pan; Stephenson wedge bolt.

Yale & Towne Manufacturing Company, The, New York, N. Y.—Trolleys; chain blocks; electric hoists; tramrail material and automatic shackles; Yale padlocks; night latches; door closers; signal padlocks; indicator padlocks; dining car locks; end door closers; general service padlocks.

Zug Iron & Steel Company, Pittsburgh, Pa.—Zug and Sable brands of staybolt iron, engine bolt iron, chain iron and forging iron.

New Books

THE TRACTIVE RESISTANCE OF A 28-TON ELECTRIC CAR. By Harold H. Dunn. Issued as Bulletin No. 74 of the Engineering Experiment Station of the University of Illinois. Copies may be had upon application to the Dean, Urbana, Ill.

This bulletin records the results of tests made with a 28-ton electric car of the double end type for the purpose of determining the resistance offered to its motion when running on straight level track in still air at uniform speed, and to ascertain the relation existing between that resistance and the speed of the car. The tests were made on sections of straight track representative of good electric railway construction, during generally fair weather when the average temperature was not below 25° F., and when the wind velocity did not exceed 26 miles per hour. The plan of the tests, which involved running the car backward and forward over a selected section of track, made it possible to eliminate wind resistance.

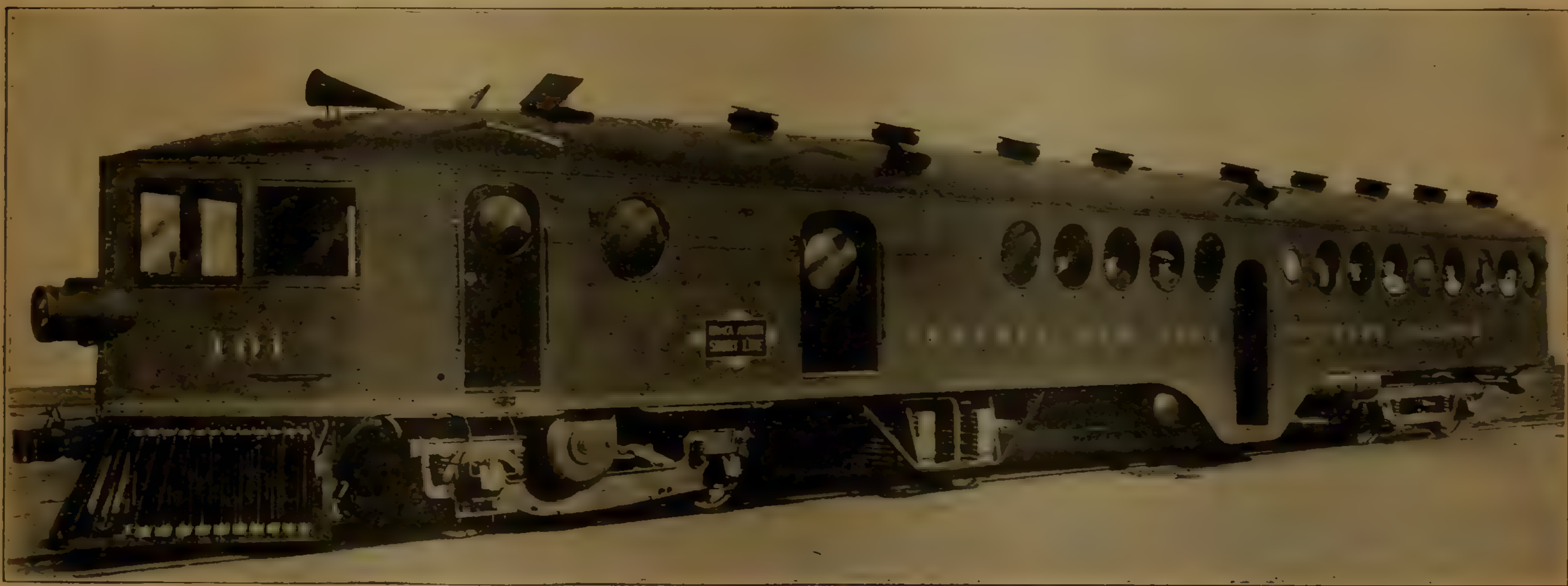
The results are finally expressed in the form of a curve whose co-ordinates are car resistance and speed. This curve shows that at 5 miles per hour the car resistance was 5.25 pounds per ton, that at 25 miles per hour it was 13.03 pounds per ton, and that at 45 miles per hour it was 26.12 pounds per ton. The average results from the individual tests did not vary more than 9 per cent from this final curve.

ALEXANDER STEWART, general superintendent of motive power of the Southern, died at Paris, France, on June 28. He was in Europe seeking to regain his health at the time of his death. Mr. Stewart was 46 years old. J. Hainer succeeds him as general superintendent of motive power of the Southern, and E. C. Sasser succeeds Mr. Hainer as superintendent of motive power of the Northern and Eastern districts.

GASOLINE MOTOR CARS, CENTRAL NEW YORK SOUTHERN R. R.

Two of the latest model motor cars have been delivered by the McKeen Motor Car Company to the Central New York Southern Railroad, Ithaca, New York. This line, extending between Ithaca and Auburn, New York, 39 miles in length, was formerly the New York, Auburn & Lansing Railroad, the corporate name of which was changed upon the recent elimination of the receivership.

Steam equipment, heretofore providing the passenger service, has in accordance with the reorganization plans been displaced by these 70 ft. motor cars, which action was considered of paramount importance in adopting ways and means of operating the passenger schedules attractively, economically and profitably.



McKeen Motor Car for the Central New York Southern R. R.

The motive power machinery of the cars is the McKeen type C, latest model, foolproof, encased, 200 horsepower gasoline engine and mechanical transmission, similar to the equipment furnished the Bessemer & Lake Erie, Soo Line and Sunset Central Lines. A description of the latter was published in the *Railway Master Mechanic* of March, 1914, page 98.

Special features with which these cars are equipped are:

The Warner railway meter, which is so constructed as to register the mileage (ahead and backing up) per trip in addition to total mileage covered.

Pneumatic gong ringer.

Steam connection for heating cars in winter when not housed at terminal.

Rear door in passenger compartment for communication between motor car and trailers.

Conductor's brake valve and pedal operated whistle in rear for use of conductor when backing up.

An illuminated indicator on rear similar to observation platform indicators on first-class passenger trains.

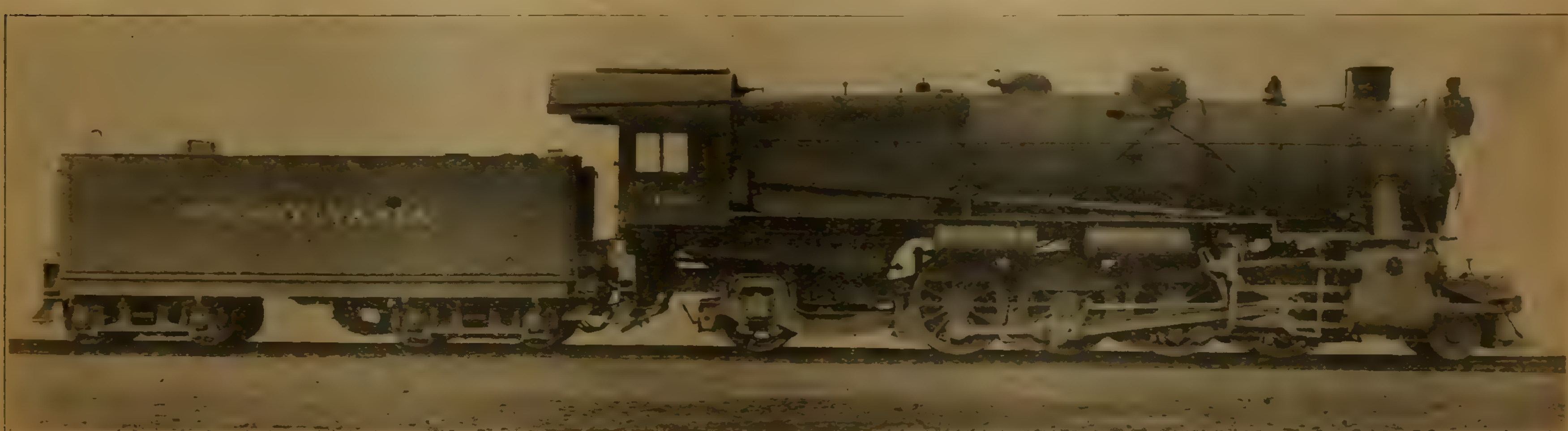
PACIFIC AND MIKADO LOCOMOTIVES, P. R. R.

During the last few years the Pennsylvania Railroad has felt the need of a larger freight locomotive for use on the main line between Altoona and Pittsburgh, in order to reduce double-heading to a minimum and to avoid breaking up trains arriving at Altoona and Pittsburgh before sending them forward over the Pittsburgh division. It was also thought desirable to experiment with a very heavy Pacific type locomotive for passenger service on this same division. With this object in view a Mikado locomotive, which will bear Pennsylvania classification "L-1-s," and a Pacific type locomotive, which will bear Pennsylvania classification "K-4-s," have been developed.

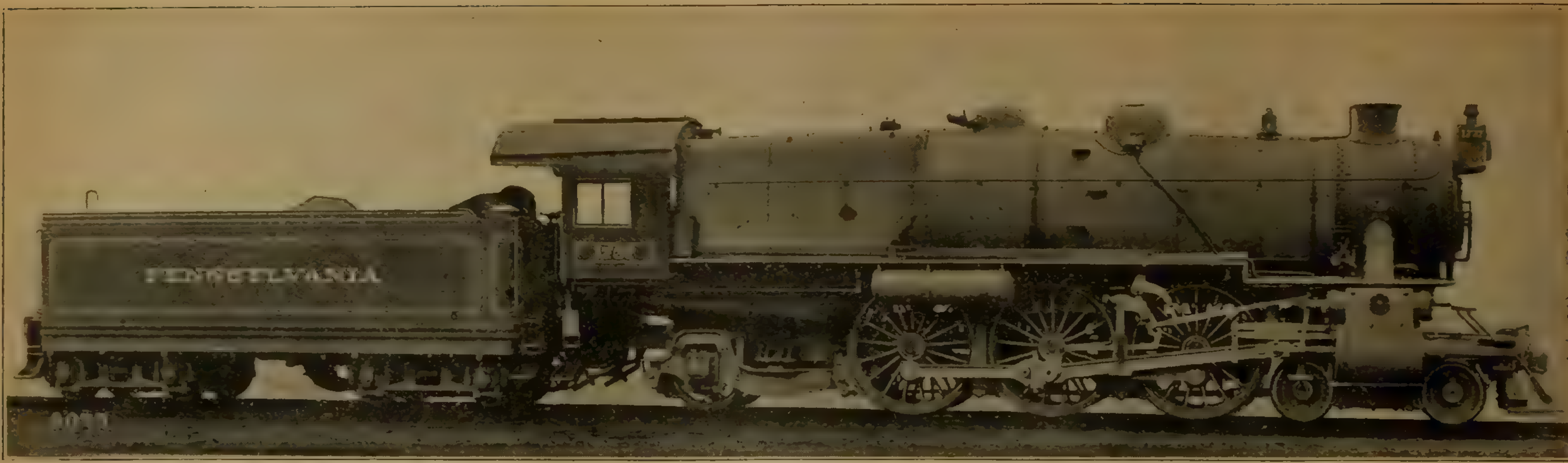
Inasmuch as the road clearance is somewhat limited, also the weight per pair of driving wheels is limited to 65,000 pounds with a five per cent margin for scale variations and the dynamic augment of the unbalanced reciprocating parts at 70 M.P.N. is limited to thirty per cent of the weight on the drivers, it was necessary to keep the locomotive within restricted limits and make the revolving and reciprocating parts as light as possible and at the same time maintain the necessary strength. Further, it was found desirable to maintain as many parts as possible interchangeable in these two type of locomotives and to use as many parts as possible which are embodied in the design of the E6s locomotives.

The following are interesting features in the design:

The design of boiler is particularly interesting in the type of flanging used. The throat sheet is flanged intergral with the lower half of the rear barrel sheet. The advantages of this scheme are that it was possible to lower the locomotive about 1⅞ inches and at the same time give sufficient clearance for the rear driving wheels, the clearance being close at this point, particularly with the Pacific type locomotive. The practice of flanging the neck sheet and the barrel sheet in one piece has been followed on quite a



Pennsylvania Class "L1" Freight Locomotive.



Pennsylvania Class "K 4 S" Passenger Locomotive.

number of our modern locomotives, also that of flanging the dome in one piece has been used to quite an extent. The boilers of the "L-1-s" and the "K-4-s" locomotives are interchangeable.

The locomotives are equipped with all-steel cabs, which are considerably smaller than the standard type of cab used on the Pennsylvania. On account of the fact that the locomotives are equipped with screw reverse gear a cab of great length is not necessary and it is believed that the shorter cab will give the engine crew better opportunity to observe signals.

The running gear has been lightened as much as possible by

Type	Consolidation	Mikado	Atlantic	Pacific
P. R. R. Classification	H9s	L1s	E6s	K4s
Gauge	4′-9″	4′-9″	4′-9″	4′-9″
Service	Freight	Freight	Passenger	Passenger
Fuel	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal
Tractive power, M.E.P.=⅘ boiler pressure	46,290	57,850	29,427	41,845
Estimated total weight in working order	250,000	330,000	240,000	305,000
Estimated total weight on drivers	220,000	262,000	133,100	200,000
Wheel base, driving	17′-0½″	17′-0½″	7′-5″	13′-10″
Wheel base, total	25′-9½″	36′-4½″	29′-7½″	36′-2″
Wheel base, engine and tender	62′-5⅞″	72′-3″	63′-10½″	71′-10″
Tractive Power x Diameter of Drivers ÷ Total heating surface*	683	622.0	599.00	580.50
Total heating surface* ÷ Grate Area	76.21	82.38	71.30	82.38
Fire box heating surface ÷ Total heating surface*, per cent	4.45	5.05	4.93	5.05
Volume both cylinders, cubic feet	15.91	19.88	13.10	18.55
Total heating surface* ÷ Volume both cylinders	264.1	290.0	300.00	310.80
Grate area ÷ Volume both cylinders	3.46	3.52	4.21	3.77
Kind of cylinders	Simple	Simple	Simple	Simple
Diameter and stroke of cylinders	25″x28″	27″x30″	23½″x26″	27″x28″
Spread of cylinders	90″	90″	85½″	89″
Kind and size of valves	12″ Piston	12″ Piston	12″ Piston	12″ Piston
Greatest travel of valves	6″	6″	7″	7″
Outside lap of valves	⅞″	⅞″	1 5/16″	1-5/16″
Driving wheels, diameter over tires	62″	62″	80″	80″
Driving wheels, thickness of tires	3½″	3½″	4″	4″
Driving axle journals, main, diameter and length	10½″x13″	11″x15″	9½″x13″	11″x15″
Engine truck wheels, diameter	33″	33″	36″	36″
Engine truck journals, diameter and length	5½″x10″	6½″x12″	6½″x12″	6½″x12″
Trailing truck wheels, diameter	......	50″	50″	50″
Type of boiler	Belpaire	Belpaire	Belpaire	Belpaire
Working pressure	205 Lbs.	205 Lbs.	205	205
Outside diameter of first course in barrel	78½″	78½″	78½″	78½″
Fire box, width and length	72″x110¼″	80″x126″	72″x110¼″	80″x126″
Fire box plates, thickness	⅜″ & 5/16″	⅜″ & 5/16″	⅜″ & 5/16″	⅜″ & 5/16″
Fire box water space	5″	5″	5″	5″
Tubes, number and outside diameter	265-2″	237-2¼″	242-2″	237-2¼″
Superheater flues, number and outside diameter	36-5⅜″	40-5½″	36-5⅜″	40-5½″
Tubes, thickness	.125″	.125″	.125″	.125″
Superheater flues, thickness	.148″	.148″	.148″	.148″
Tubes, length	180″	228″	180″	228″
Heating surface tubes, saturated	2841.2	3746.8	2,660.5	3,746.8
Heating surface fire box, saturated	187.0	288.6	195.7	288.6
Heating surface, total, saturated	3028.2	4035.4	2,856.2	4,035.4
Superheater heating surface	782.2	1153.9	721.0	1,153.9
Grate area, square feet	55.13	70.0	55.13	70.0
Dome, height above rail	180″	180″	180″	180″
Center of boiler above rail	9′-9″	9′-9″	9′-10″	10′-1″
*Equivalent heating surface, square feet	4,201.5	5,766.3	3,937.7	5,766.3

the use of heat-treated material for driving axles, crank pins, piston rods and side and main rods. The axles, crank pins, wrist pins and piston rods are provided with holes through them with a view to reducing the weight and at the same time providing a better chance for the heat-treatment to take effect.

The trailer truck is what is known as the K-W truck, this truck being interchangeable on the E6s, L1s and K4s locomotives.

The driver brake arrangement is particularly interesting on account of the arrangement of cylinders, this arragnement being necessary to provide sufficient space for two 16-inch cylinders which are necessary for proper control.

The locomotives are equipped with Schmidt smoke tube superheaters and Security fire brick arch.

The tenders are of the water bottom type with 36" wheels and 5½"x10" journals. They have a capacity of 7,000 gallons of water and 25,000 pounds of coal.

A comparison of the various classes is given on the opposite page.

THE SHOP FIRE DEPARTMENT.

By Louis Brentnall.

Fires, generally speaking, result from carelessness. Many shop fires, resulting from different causes, occur every year, and any master mechanic can tabulate a list of these fire-starting hazards by reading current numbers of the railroad journals, as well as by reviewing old issues of these exponents of the best shop practice. The clippings may be pasted in a scrapbook under headings which denote the various primary causes which are accredited as occasioning shop fires.

The master mechanic may require the foreman of each shop to see that any irregularity which might cause a fire is overcome either by the foreman reporting the deficiency to him or by issuing timely orders to remove the hazard. Where the master mechanic gives his foreman a list of fire-starting causes the foreman will know just what irregularities to look for, as well as where to find them. A man can accomplish much more when he is guided by systematic data than if he were to make a promiscuous inspection without knowing what he was expected to find, and consequently overlook everything because he couldn't see by reason of his unenlightened vision. Of course, a foreman cannot do everything and at the same time attend to his supervisory duties, and consequently he may appoint subordinates to look for certain fire risks and report their findings to him.

Fire insurance, although a good protection financially, does not cover the complete loss of a shop building or its contents when it is taken into consideration that a railroad company without a repair shop is in bad shape and the daily loss resulting from the inability to make repairs to rolling stock may amount to more than the shop loss in a few weeks.

While a master mechanic may do all in his power to prevent fires, yet one may start from some cause at almost any time, and consequently the shop must have fire protection, in addition to measures of inspection and prevention.

Among preventive measures is the sign, "No Smoking!" Another sign may read, "Throw greasy waste in this lid-protected pail!" Men should be required to have their overalls washed at certain periods, as these in time become a fire hazard by reason of the grease and oil which has accumulated on them; or, the clothing should be placed in steel lockers. A little observation will suggest other hazards of like nature, as will also the master mechanic's scrapbook on "How Shop Fires Originate."

Each shop should be provided with efficient means of battling with fire. Most fires start in a small way and can be put out if discovered quickly, but in order to put them out there must be at hand necessary equipment for quenching the fire before the flames become scattered in various directions. Sand is used in fighting oil fires and salt is also sometimes preferable to water in putting out a fire. Each shop should have a number of fire extinguishers and waterstands in the shop, with hose connected to them ready for use, effecting a great saving in time.

Of course, the equipment must be varied according to the particular shop to be protected and its surroundings. A fire in the shavings in car shop or planing mill may spread rapidly, hence the necessity for keeping the premises free from litter. Burn the shavings and scrap car sheathing or sell them daily. The same precaution pertains to rip-tracks and other buildings—keep the premises clean while work is going on.

Every well regulated railroad shop should have a regular fire department composed of a number of experienced firemen who are directed by a fire chief. There are many ways of maintaining the personnel of such a department. Preferably, the firemen should be on regular fire duty—especially at night. It will be found expedient to provide them with more than one means of reaching a fire with their fire apparatus. A motor car may house a regular fire engine and also pull a water car with it to a fire. An outfit of this kind is what is needed in reaching some fires, as at lumber yard or on a long rip-track. Of course, where local water facilities are good at such points, or hose is already connected up to a hydrant, the necessity for the engine decreases. Whatever facilities are necessary should be gotten and manned. Where auxiliary facilities are used the firemen need simply rush to the shop which is afire, hauling perhaps only a chemical extinguisher and a hose reel, as a precaution in case they are repelled by the fierceness of the fire from entering the shop. Hydrants or booths with hose connections should be on the outside of shops, as well as inside. Additional water pressure should be put on at the shop power house as soon as the alarm sounds.

While the fire department may be provided with a hook and ladder cart, yet it will be found that such an outfit is a difficult one to handle around a shop, and consequently it is better to provide the shop walls and roofs with ladder irons, or ladders similar to those used as fire escapes on commercial buildings. Then the firemen can climb the fire ladders, thus saving the time of hauling a hook and ladder wagon and also the time of setting the ladders in place.

Each shop should have a number of volunteer firemen, selected from among the shopmen. These men should receive special training from the fire chief regarding handling a fire in the particular shop in which they are at work, should one occur while they are on duty. They should have an assistant fire chief to direct them until the regular fire department arrives.

Firemen must keep in practice, the same as workmen, and maneuvers of some kind should be gone through every day in order that the firemen may be at full efficiency when a fire occurs. A false fire alarm may be sent in once a week. Each man should be shown how to handle the fire extinguishers and the best ways of fighting fire.

A shop fire department should fully pay for itself where it is required to protect depots, storehouses, lumber yards, rip-tracks, etc., as well as the shops. Some railroads depend on the city fire department, but where the shops are large or the buildings are several in number it is best to have a shop fire department, calling on the city fire department only in case of a conflagration. As a general thing, a fully equipped shop fire department can extinguish a shop fire before the flames spread or the damage amounts to any particular amount, whether the fire be in one building or another.

Shop fire alarm boxes may be installed in numerous places in each shop, as well as around the yards. The system employed may be similar to that used by city fire departments. When a fire starts, an individual alarm should at once be sounded in the shop which is on fire, in order that the assistant or volunteer firemen may put it out. Some shop fire departments use the shop whistle. A good bell is as good, especially in an individual shop, as its ringing calls both the assistant and regular fire departments at the same time.

Each shop should have one or two watchmen who make regular rounds, and whose principal duty is that of being on the lookout for fire. Some watchmen, also, are sometimes given other duties, such as sweeping or cleaning, but this is detrimental to their efficiency.

Generally speaking, fire insurance is the cheapest thing on the market and shops should be reasonably protected by fire insurance

policies, but with an efficient shop fire department a railroad company can feel secure that the chances of having a conflagration are so rare that buildings and equipment may not be fully protected by insurance. Years ago a heavy fire insurance protection was generally necessary, while today some railroad property is protected by insurance in accordance with the company's fire preventive measures and fire fighting facilities, as the main thing is not to have the shop burn down at any time, regardless of insurance.

Any master mechanic without shop fire facilities should include in his budget of needed shop equipment, such fire fighting paraphernalia as may be required in preventing his shop from burning down.

At the time he should organize some kind of fire brigade, or increase the efficiency of the one he has by letting them install preventive measures and practice fire drills. Proper drilling overcomes excitement when a fire occurs.

Preventive measures, good fire fighting equipment and an efficient shop fire department are the three main features which overcome conflagrations.

Personals

H. Shoemaker has been appointed mechanical superintendent of the *Bangor & Aroostook* with office at Derby, Me. As announced in the June issue, Mr. Shoemaker's railroad career was started as an apprentice in the old Lehigh Valley shops at Wilkes Barre, Pa., in March, 1886. He received his first promotions from machinist to gang foreman and from gang foreman to general foreman in this same shop. In 1901 he was made general foreman of the locomotive department of the Lackawanna at Scranton in the old Scranton shops. He continued in this capacity up to August, 1903, and at that time was made master mechanic of the Scranton division of the same railroad. In May, 1911, he resigned to take up shop construction work for the New York, Ontario & Western at Middletown, N. Y. After the construction work at Middletown was completed, he was made shop superintendent, and continued in this capacity up to June 1, 1914, when he accepted the above mentioned position.

W. J. Renix succeeds F. R. Pennifather as district master mechanic of the Alberta division of the *Canadian Pacific* at Cranbrook, B. C.

F. B. Fisher has been appointed master mechanic of the *Central New England* at Hartford, Conn., succeeding A. A. Harris.

J. E. Dougherty succeeds F. B. Fisher as master mechanic of the *Central New England* with office at Poughkeepsie, N. Y.

W. G. Mahnes succeeds W. R. Noel as general foreman of the *Chesapeake & Ohio* at Cone Fork, W. Va.

J. Pfeiffer succeeds W. Augustus as master mechanic of the *Chicago, Burlington & Quincy*, with office at Centerville, Ia.

W. W. Eldridge has been appointed piece-work inspector of the *Chicago, Burlington & Quincy*, with office at Chicago.

D. C. Curtis succeeds W. W. Eldridge as inspector of stores of the *Chicago, Burlington & Quincy* with office at Chicago.

A. Helbrecht succeeds R. C. Cross as locomotive foreman of the *Chicago, Great Western* at Hayfield, Minn.

R. C. Cross, locomotive foreman of the *Chicago, Great Western*, has been transferred from Hayfield to Minneapolis, Minn.

F. E. Botsford succeeds A. L. Hamlin as car foreman of the *Chicago, Great Western* at St. Joseph, Mo.

Martin M. Dick succeeds C. S. Roof as general car foreman of the *Chicago, Terre Haute & Southeastern* with office at Terre Haute, Ind.

W. T. Madden succeeds R. L. Blake as foreman freight car shops of the *Intercolonial* at Moncton, N. B.

P. C. Morales succeeds M. J. Schneider as superintendent mechanical department of the *National Railways of Mexico* with headquarters at Aguascalientes, Aguas, Mexico.

Melvin S. Montgomery succeeds C. Emerson as road foreman of engines of the *Northern Pacific* at Duluth, Minn.

John Horan has been appointed acting master mechanic of the *Northern Pacific* at Minneapolis in place of J. B. Neish, on leave of absence.

R. E. Hammond has been appointed acting road foreman of engines of the *Northern Pacific* at Minneapolis in place of John Horan.

A. C. Hinckley, superintendent of motive power of the *Oregon Short Line*, has had his headquarters transferred from Salt Lake City to Pocatello, Ida.

D. J. Malone, master mechanic of the *Oregon Short Line*, has been transferred from Ogden, Utah, to Pocatello, Ida.

David Gratton has been promoted to master mechanic of the *Oregon Short Line* at Pocatello, Ida.

B. Kimball has been appointed general foreman, locomotive department, of the *San Antonio, Uvalde & Gulf* with office at Pleasanton, Texas.

Ernest Baxter has been appointed purchasing agent of the *St. Louis, Southwestern*, vice J. E. Sargent. His office is at 1743 Railway Exchange building, St. Louis, Mo.

W. E. Kimball succeeds Robert Hoye as general foreman car department of the *St. Louis & San Francisco* at Monett, Mo.

Alonzo G. Kinyon has been appointed superintendent of locomotive operation of the *Seaboard Air Line* with office at Norfolk, Va. He was formerly locomotive fuel engineer of the Clinchfield Fuel Co. at Spartanburg, S. C.

C. O. Destiche has succeeded H. J. Osborne as superintendent of motive power of the *South Dakota Central* with office at Sioux Falls, S. D.

J. Hainen has been promoted to general superintendent of motive power and equipment of the *Southern*, succeeding the late Alexander Stewart. His headquarters are at Washington, D. C.

E. C. Sasser has been promoted to superintendent of motive power of the eastern and northern districts of the *Southern* with office at Washington, D. C., succeeding J. Hainen.

J. C. Schepp, general foreman of the *Texas & Pacific*, has been promoted to master mechanic with office at Texarkana, Texas, succeeding George M. Lovett.

J. A. Carleston, general foreman of the *Texas & Pacific*, has been transferred from Big Springs, Tex., to Marshall, Tex.

W. T. Kuhn has been promoted to superintendent of motive power of the *Toronto, Hamilton & Buffalo* with office at Hamilton. Ont.

E. L. Fries succeeds J. H. Stafford as general storekeeper of the *Union Pacific* with headquarters at Omaha. Mr. Stafford retires under the pension rules of the company.

Alexander Stewart.

OBITUARY.

ALEXANDER STEWART, general superintendent of motive power and equipment of the *Southern Railway*, died suddenly at the Hotel Continental in Paris, France, June 28th. Mr. Stewart had been in bad health for several months and upon advice of his physician on June 16, accompanied by his wife and only daughter, Miss Eleanor, sailed on the Mauretania for Bad Nauheim, Germany, where it was hoped he would fully regain his health. His death, coming as it did, was a great shock to his many friends and associates.

Mr. Stewart was 46 years old and widely known in the railway world as one of the most capable and experienced men of his profession. He was born in Fort Wayne, Ind., and began at an early age to prepare for the railway business. He was master mechanic of the Union Pacific with headquarters at Cheyenne, Wyo., for a number of years, when he accepted a similar position with the Southern with headquarters at Knoxville, Tenn. He was later promoted to general superintendent motive power and equipment with headquarters at Washington and also chairman of the committee on mechanical standards of the Southern and the following affiliated lines: Alabama Great Southern; Cincinnati, New Orleans & Texas Pacific; Mobile & Ohio, and Georgia Southern & Florida, which positions he held for the past ten years and occupied at the time of his death.

In 1910 he was sent as a delegate to the International Railway Congress, which was held at Berne, Switzerland, and in 1911 he was elected president of the Master Car Builders' Association. He was also a member of the Master Mechanics' Association. There was no man who was held in higher esteem than Mr. Stewart by his associates as well as those who served under him. He was widely known in fraternal and club circles. He was a Knight Templar, a 32° Mason, a member of the Mystic Shrine, a life member of the Elks and a member of the Commercial Club, the Columbia Country Club and the Angler's Club of Washington, D. C.

Among The Manufacturers

LOCOMOTIVE CYLINDER AND VALVE SEAT BORING BAR.

A boring bar specially designed for reboring locomotive cylinders and valve seats is illustrated herewith. It can be used with one or both heads removed and is easily set in any cylinder or valve seat. The crosshead blocks are bolted to the cylinder with the cylinder head studs and the bar revolves in the sleeves supported and centered by the set screws in the crossheads.

The driving power is transmitted by means of a two-speed, quick change gear drive. This is a recent improvement of particular advantage when the same bar is used to rebore cylinders and valve seats, where a change of pulleys on the primary shaft will not give sufficient range of speed. The "quick change" is accomplished by simply pulling out a slip pin, shifting the primary pinion out of gear and placing the pulley on the intermediate shaft.

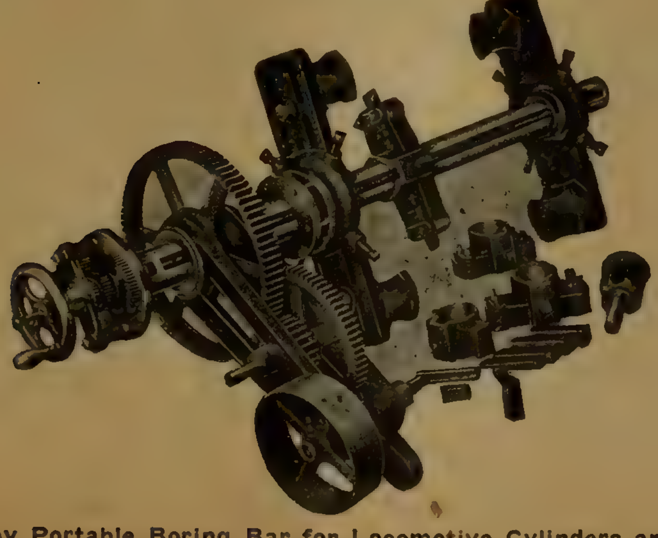
The automatic feed case has two changes of feed controlled by a slip pin. The double arm cutterheads have screw adjustment for the tools. The expanding chuck has five sets of taper gibbs to fit the stuffing boxes and support that end of the bar, when boring with only one head removed.

This boring bar is manufactured by E. J. Rooksby & Co., Philadelphia, Pa.

SCARRITT CAR SEATS.

The Scarritt car seats were a feature of the World's Fair at St. Louis in 1904, the Scarritt Company having a pavilion in the Transportation building. The exhibit was devoted to the special features of the Scarritt railway coach seats. A London railway equipment concern, having now for the first time use for car seat equipment, buys the Scarritt coach seats, stating that it was impressed with the showing then made, and retained the advertising matter handed its representatives. The Scarritt people were able to show great improvements in their seats in the ten years, and while the English firm were satisfied with the former seat, they were quickly convinced of the advance made in car seat manufacture as offered by the Scarritt house, and ordered the late productions.

George T. Parker, president of the Scarritt company, has just returned from a business trip to South America, where he took in the principal business cities. In the "A B C" republics it was his pleasure to find the Scarritt car seats sold 10 or 15 years ago, still in use and still in first-class shape—the covering was in most cases of horse hide of a special quality which has stood the hard usage given them for this long period. This speaks well for the Scarritt car seat, made at St. Louis.

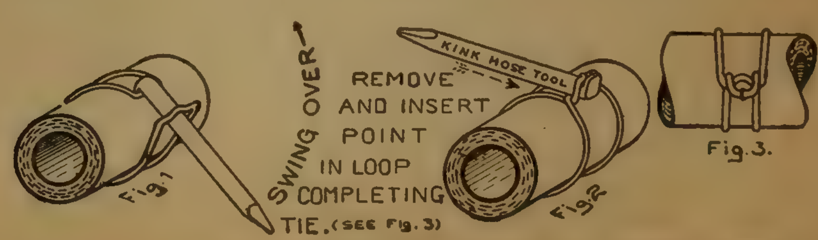


Rooksby Portable Boring Bar for Locomotive Cylinders and Piston Valve Seats.

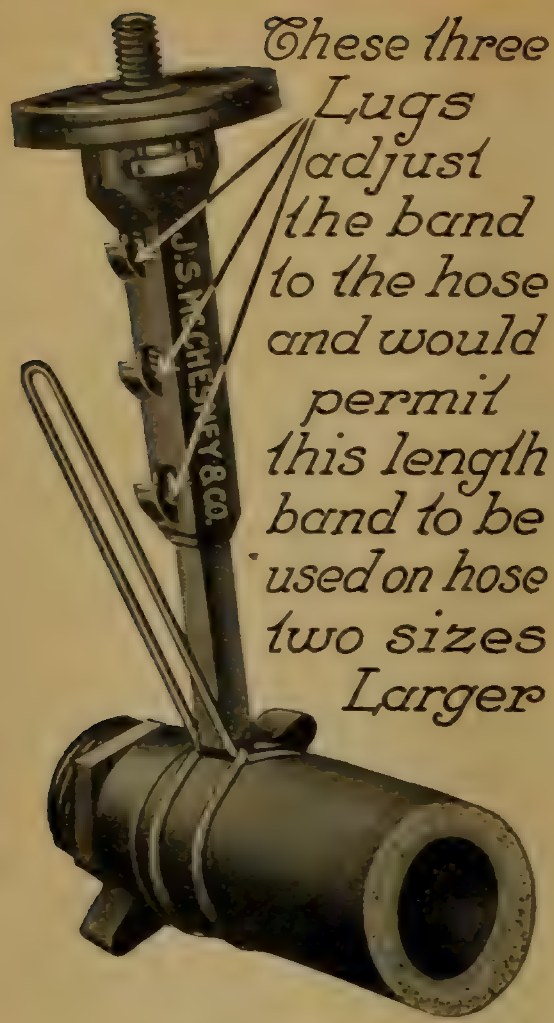
GALVANIZED STEEL WIRE HOSE BANDS.

A new and successful departure in the method of applying bands to small size water and pneumatic tool house has been put on the market by J. S. McChesney & Co., of Chicago. A tool which is furnished in each package of bands is simple in construction and convenient to carry in the pocket and should it be lost it may easily be duplicated by removing a portion of the head of a sixty-penny spike. Under tests the bands proved to have greater holding power than brass clamps and in addition are free from projecting ears.

This concern also manufactures a band which is easily applied by means of their universal hose tool and having the advantage that one length of band can be adapted to two or more sizes of hose irrespective of the number of ply. The galvanized steel wire bands are inexpensive, strong and are quickly and easily applied. The band exerts a uniform pressure upon the



Kink Hose Tool.



Universal Hose Tool.

entire circumference of the hose and from the illustration it will be noted that there are in reality two bands on the hose, thus doubly insuring the holding power.

NEW BRICK ARCH FOR LOCOMOTIVE FIREBOXES.

The use of arches in locomotive fireboxes is now so general as to be considered standard practice. A number of railways have used the arch in locomotives of certain types for years. More recently railway officers have been educated to believe in the arch as a necessary part of the equipment for locomotives of all classes.

A new design in brick arches has been developed and is manufactured by the Locomotive Arch Brick Co., Chicago. The drawing herewith shows the details of an installation of the new arch. Its particular advantages are the small size of its units, the arched shape of center units, the non-wedging design of the side units, and lack of any overhanging ends.

The small size of units lends to the economy of the arch in that the different parts of the firebox are readily accessible and the replacing of broken brick is made at small cost.

A marked advantage is that of the construction of the brick which form the outside rows. As shown in the section, these outer brick are designed with a projecting rib which rests against the side sheet in such a way that they move vertically with lateral movement of the side sheets and do not wedge and force the arch tubes out of position.

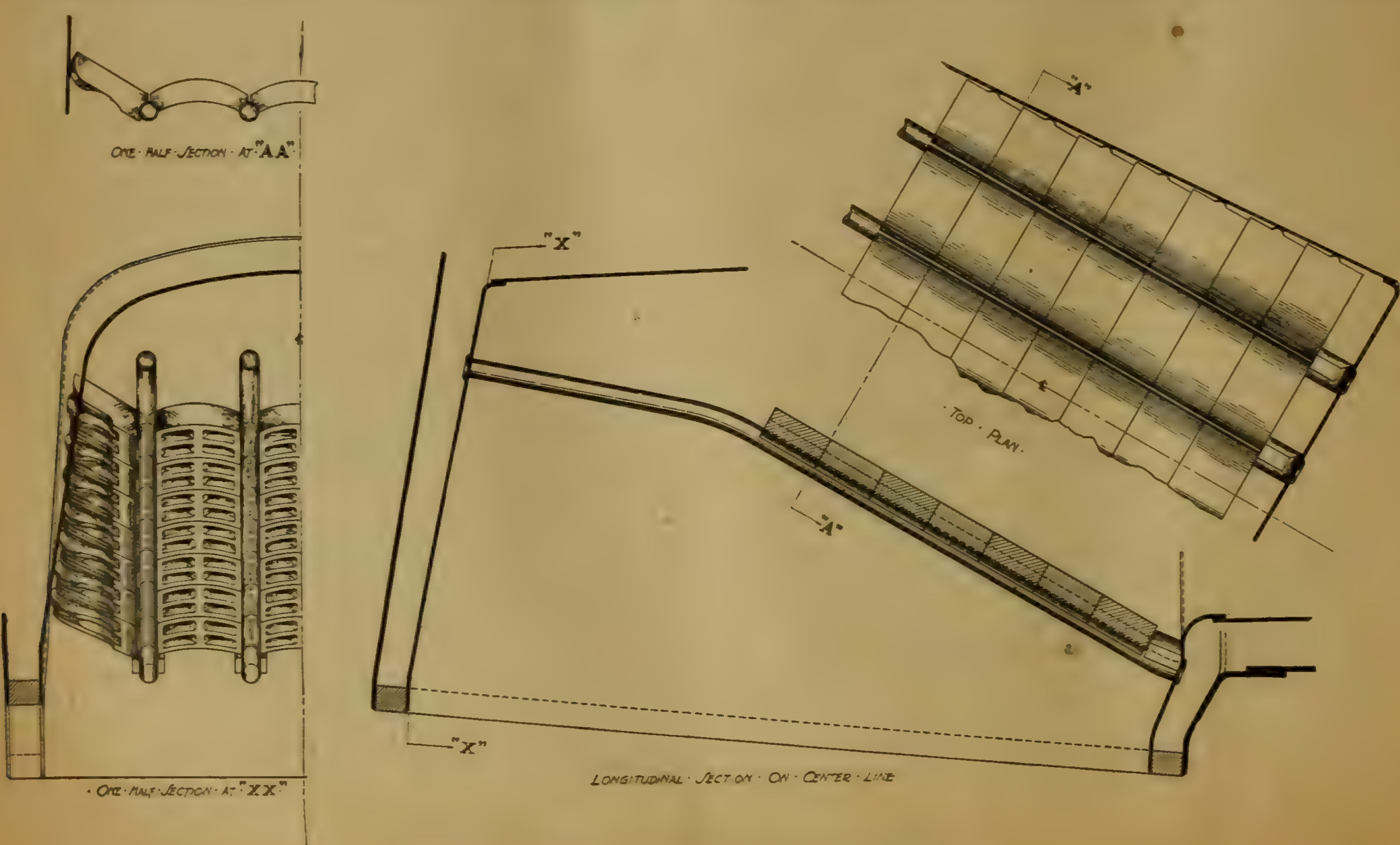
The arched shape of center brick tends to lengthen the life of the arch, as each brick forms for itself a better support than if moulded flat, and it is thus possible to wear it much thinner.

The result of considerable practical experience is evident in the design of the arch units as the major causes of arch trouble, as met with in the past, seem to have been eliminated, as, for instance, the precaution against the fusing together of the ends of the brick and the absence of overhanging ends.

This arch, which is known as the "Economy," has been adopted, it is stated, by five of the larger sustems and its performance has been to them satisfactory.

The Locomotive Arch Brick Company was organized in June, 1913, by J. W. Moulding, president; T. C. Moulding, secretary and treasurer; E. P. Stevens, vice-president, and J. L. Nicholson, vice-president and general sales manager.

Both J. W. Moulding and T. C. Moulding have been manufacturers of refractory material since 1866, and now own and control seven large, modern fire brick plants, the Locomotive Arch Brick Company being the sales organization covering the output of locomotive arches. E. P. Stevens and J. L. Nicholson



Detail of Installation in Firebox of Economy Brick Arch.

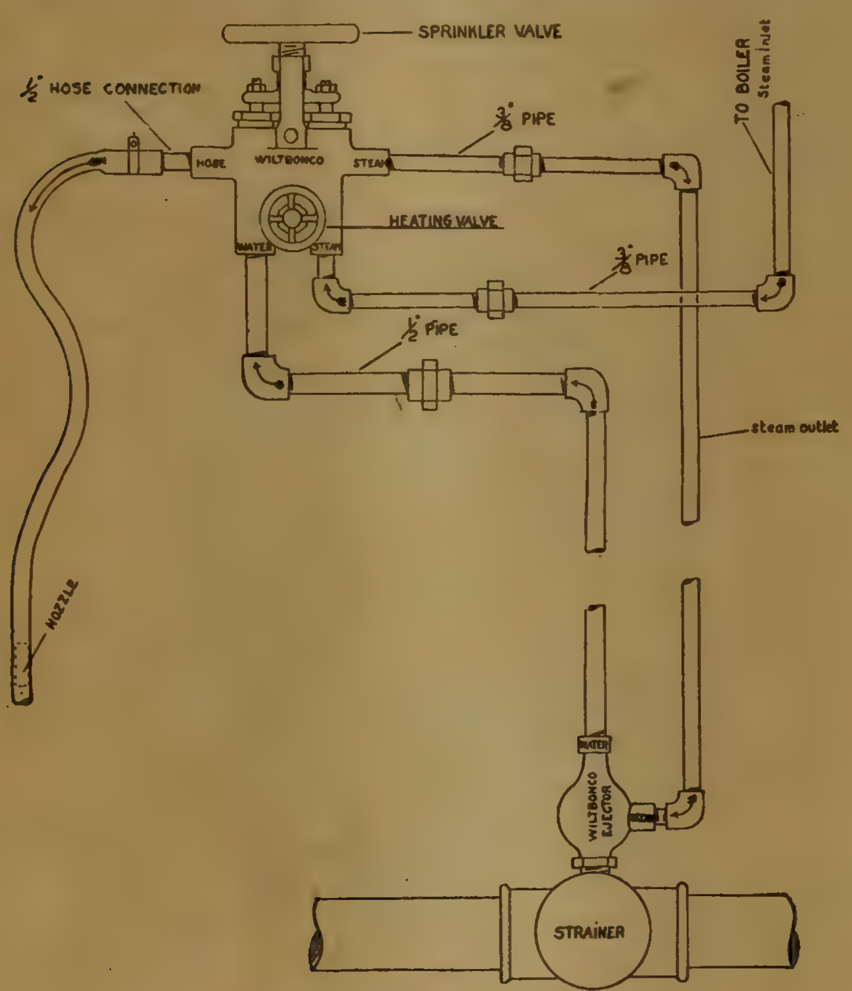
View of Side Brick Showing Curved Construction of Projecting Rib.

are practical arch brick men with over fifteen years experience and have had considerable to do in developing the brick arch to its present state of efficiency.

WILTBONCO COAL SPRINKLER.

The drawing shows the general arrangement of installation for the Wiltbonco "Type B" locomotive coal sprinkler. This device was shown in action at the Atlantic City conventions this year.

The sprinkler is designed to give warm water at moderate



Wiltbonco Coal Sprinkler.

pressure, under all conditions, at the hose nozzle. It is safeguarded against freezing and is sure in its action.

The double valve is placed at a convenient point in the cab. The ejector is placed on the injector water feed pipe or on the strainer. The piping and other connections are simple.

New Literature

The Gisholt Machine Co., Madison, Wis., has issued a folder descriptive of its 42-inch boring mill, showing its especial adaptability for machining locomotive driving boxes.

The Ryerson high-speed friction saw and the Lennox serpentine shear are the subjects of two bulletins recently issued by Joseph T. Ryerson & Son of Chicago. The Lennox shear was described on page 128 of the March issue of the *Railway Master Mechanic.*

* * *

The Chicago Pneumatic Tool Co., Chicago, has issued a booklet covering classes A-O and A-C fuel oil and gas engines. This firm has also issued a bulletin on "Chicago Pneumatic" gasoline and fuel oil engine-driven compressors.

* * *

Forging machine talk No. 3 of the National Machinery Co., Tiffin, O., deals with the value of large "gather" in the forging machine.

* * *

The Ingersoll-Rand Co., New York, has issued a reprint of an article by Emory R. Johnson entitled "What the Panama Canal Will Accomplish," which appeared in the July, 1913, issue of Scribner's. It contains twenty-six photographic reproductions in colors. Ingersoll-Rand drills were very extensively used on the canal.

* * *

Leaflet No. 204 of the Dayton Mfg. Co., Dayton, O., gives an illustration and brief description of an improved refrigerator latch, while leaflet No. 174 describes a vestibule door half-mortise latch.

* * *

Two leaflets recently issued by the Gold Car Heating & Lighting Co., New York, take up the Gold packless quick opening supply valves Nos. 938 and 940.

* * *

Smooth-On instruction book No. 7, issued by the Smooth-On Mfg. Co., Jersey City, N. J., is devoted entirely to the use of Smooth-On iron cement for hardening, waterproofing and oilproofing concrete. It gives full directions for the above work and shows photographs of work done.

* * *

The July number of "Drill Chips," the monthly house organ of the Cleveland Twist Drill Co., Cleveland, O., is in commemoration of the firm's fortieth year in business and explains by illustrations and descriptions the various processes through which a drill goes in the course of its manufacture. This little house organ is distinctive, readable and worth while.

* * *

Catalogue No. 44 has just been issued by the Bury Compressor Co., of Erie, Pa. It contains several illustrations of installations of Bury three-cylinder and two-cylinder variable volume air compressors, together with descriptions and other matter of interest.

* * *

The Universal Car Seal & Appliance Co., of Albany, N. Y., has issued a folder giving details of the Universal car seal.

* * *

The Gold Car Heating & Lighting Co., New York, recently issued a new catalogue embodying a brief but complete description of its various electrical products and ventilators. These include electrical car heaters of different styles and sizes.

* * *

The Goldschmidt Thermit Co. of New York has issued a book of instructions on the use of Thermit in railway shops. The booklet contains 52 pages and gives complete directions together with many suggestions as to the use of Thermit. It also contains a large number of illustrations.

* * *

A very elaborate catalogue of electric lighting fixtures for railway cars has been issued by the Safety Car Heating & Lighting Co. of New York. It contains 95 pages bound in embossed paper covers and contains many excellent half-tone reproductions of lighting fixtures.

Pratt & Whitney, of Hartford, Conn., have published a 34 page catalogue dealing with their side-head boring mill. This machine has a side head which is operative on work up to 38 inches in diameter and a vertical head operative on work 44 inches in diameter. Many illustrations of the details of the machine are given.

* * *

The 1914 catalogue of Tate flexible staybolts and tools for its installation has been issued by the Flannery Bolt Co. of Pittsburgh, Pa. It contains thirty pages of illustrations and descriptions and is a very creditable and valuable piece of work.

* * *

"Heat Treating Furnaces" is the title of a thirty-page booklet of Tate, Jones & Co. of Pittsburgh. It describes this company's furnaces for annealing, hardening and tempering steel, the descriptions being preceded by a short article on scientific management applied to steel.

The Selling Side

DUDLEY O. JOHNSON has been appointed branch manager of the Chicago office of the Joseph Dixon Crucible Company. He succeeds the late Sam Mayer.

JOHN F. WALLACE, consulting engineer, has moved his Chicago office to 859 Insurance Exchange building.

THE AMERICAN MASON SAFETY TREAD CO., since January 1, 1914, has furnished somewhat over 10,000 square feet of safety tread to the Interborough Rapid Transit Company, New York, for the stairs and platforms of its subway and elevated stations. The company has not felt any effects of the general business depression and its business up to date exceeds that of last year.

C. H. MCCORMACK has been promoted to vice-president of the Standard Heat & Ventilator Co., with office at 1949 Peoples Gas building, Chicago.

GEORGE C. ISBESTER, for the past three years attached to the New York office of the Rail Joint Co., has been given charge of its Chicago office, at 215 Railway Exchange building.

J. H. JOHNSON has resigned as secretary and treasurer of the Union Switch & Signal Co., and T. W. Siemon has been elected secretary and treasurer to succeed him.

JAMES M. SWANK, at one time editor of *Iron Age* and formerly vice-president and general manager of the American Iron & Steel Association, died at his home in Philadelphia on June 22.

THE HATFIELD RAIL JOINT MANUFACTURING CO. of Macon, Ga., has entered into arrangements with T. B. Bowman, formerly Ass't to the President of The Q. & C. Co., New York, and now of The Efficiency Co., to assume general charge of the sales of the Hatfield Rail Joint with offices at No. 2 Rector Street, New York and 700 Railway Exchange, Chicago.

HARLOW D. SAVAGE, who was recently appointed general eastern sales manager of the AMERICAN ARCH CO., has been elected vice-president of that company.

L. R. POMEROY, a railway and electrical engineer of prominence, has been appointed manager of the New York sales office of the U. S. LIGHT & HEATING CO. L. R. Pomeroy has under his direction the sales of the U.-S.-L. Axle Electric Car Lighting Equipment, U.-S.-L. Electric Starter, Lighters and Storage Batteries in the territory of the New York Branch Office.

J. A. Bodkin has resigned his position as engineer for the Q. & C. Co. to become associated with his brother in the TRACK SPECIALTIES CO., 29 Broadway, New York City.

HARVEY W. BELL, founder of the Bell Locomotive Works, Inc., is now connected with the H. K. PORTER CO., Pittsburgh, Pa., in the manufacture of gasoline steam locomotive.

H. P. WEBB, Wainwright building, St. Louis, Mo., has been appointed railway sales agent for St. Louis by the Union Fibre Co., Winona, Minn.

G. FRED COLLINS, who has been representing the Protectus Paint Co., at Pittsburgh, Pa., has resigned to engage in other business.

The Seattle office of the AMERICAN HOIST & DERRICK CO. has been moved from 613 Western avenue to 1512 L. C. Smith building. The L. C. Smith building is one of the highest and best equipped office buildings in the country, and its central location will be more convenient for out of town customers.

THE U. S. METAL & MANUFACTURING CO., of New York City, has discontinued its eastern agency with the Pollak Steel Co., of Cincinnati.

THE TITANIUM ALLOY MANUFACTURING CO. has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. Wm. M. Corse, formerly works manager of the Lumen Bearing Co., Buffalo, N. Y., and lately general manager of the Empire Smelting Co., Depew, N. Y., will be associated with the company as manager of this department.

Due to the increased activities of the railway and lighting department of the Westinghouse Electric & Mfg. Company in connection with the work of railroad electrification and heavy power house apparatus, the management has created the positions of assistant managers of this department. Messrs. E. P. Dillon and M. B. Lambert have been appointed to these positions. Mr. Dillon will have charge of the commercial activities of the company in connection with the generation and distribution of power, involving power house, substations, transformer stations and similar apparatus. Mr. Lambert will have charge of all sales work pertaining to electric traction, including steam, interurban and city railway propositions. Both Mr. Dillon and Mr. Lambert have been connected with the railway and lighting department of the Westinghouse Company for a number of years and are widely known in the electrical profession.

W. G. WILLCOXSON has accepted a position as representative in the railway department of the Garratt-Callahan Company, with offices at 27 S. Clinton St., Chicago, Ill. Mr. Willcoxson has had a broad experience in the mechanical departments of railroads in

W. G. Willcoxson.

both car and locomotive work. He has been in the railway supply business for some time and enjoys a large acquaintance among the railway and supply men, and has been a member of the Western Railway Club and Car Foremen's Association for many years. He is a son of the late George J. Willcoxson, who for years was connected with the car departments of the Illinois Central and Michigan Central Railroad.

MUDGE & COMPANY of Chicago are now representing in western territory the Chambers Valve Company of New York. The Chambers throttle valve now being exclusively manufactured by the latter company was recently acquired from the Watson-Stillman Company. This device is well recommended and on a number of large railroads it is being used extensively.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: House Bldg., Pittsburgh, Pa.
Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.
This Publication has a larger circulation than any other among mechanical department officers. Of this issue 5,200 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, August, 1914 No. 8

CONTENTS.

Statistics.

As a general thing, statistics are pretty uninteresting, but the few figures following are worth a railway man's attention, for they give him an idea of the vastness of the business in which he is engaged. Incidentally, they give an indication of the size of the job the Interstate Commerce Commission has on its hands.

An advance abstract of the statistical report of the Interstate Commerce Commission for the fiscal year ending June 30, 1913 (which is the latest report), gives a number of interesting statistics with regard to railways having operating revenues above $100,000. Returns of switching and terminal companies are not included. On June 30, 1913, there were in service 63,378 locomotives, an increase of 2,102 over the previous year. Of this total number, 14,396 were passenger locomotives, 37,924 freight, 9,834 switching, and 1,224 unclassified. The total number of cars of all classes was 2,445,508, assigned as follows: passenger service, 51,700; freight service, 2,273,564; company's service, 120,244. These figures do not include private car lines. The total number of persons on the pay rolls of the steam roads was 1,815,239, and the amount of money paid in wages and salaries during the period referred to was $1,373,830,589. The number of passengers carried was 1,033,679,680, and the number of tons of freight was 2,058,035,487.

Welding in Railway Shops

The various improved, and what might be called portable welding processes, are now in general use in many railway shops. A paper on this subject, entitled "Autogenous Welding," was presented at the recent convention of the General Foremen's Association, and the fact that it brought out one of the best discussions of the convention indicates that there is considerable difference in the practices and methods employed at different shops. Extracts from the paper are published elsewhere in this issue, but many illustrations and records of welds had to be omitted, due to lack of space.

The paper and discussion in the first place emphasized the fact that all of the various processes were being used and that no one method had gained any general pre-eminence.

In fact, many shops reported that they had in use all three improved processes, namely, electric, oxy-acetylene and Thermit, together with the old oil welding process. No marked limitations of any process were brought out, but the discussion showed that many of the members found that certain methods were particularly successful on certain work, as for instance, electric welding for flues, oxy-acetylene for side-sheets and cutting, and Thermit for side frames. Quite a number of shops have permanent equipment for the various processes, as generators and pipe lines throughout the shop for oxy-acetylene, plugs for electric current and Thermit trucks containing the complete welding outfit. Many remarkable savings by the use of the above processes were reported, but it is evident that the possibilities of welding in railway shops have not yet been exhausted.

The essentials of making a good weld are to keep the surfaces clean, to work quickly and to provide against undue and unequal contraction in cooling. The secret then is in having

an operator of ability who recognizes these essentials, and it has been said that blacksmiths with their already acquired knowledge of metals, become very skillful operators. Although, of course, different shops have different conditions to meet, the operator is the one primarily responsible for the success or failure of this work. This is confirmed by the fact that some shops get excellent results in doing certain jobs, while others have only medium or poor success. The man who makes the welds should be a high-class man—he is the dentist of the shop.

In the discussion of the paper previously referred to, quite a number reported more or less difficulty in the welding of cast iron. One of the members thereupon stated that he had been very successful in welding cast iron cylinders and he attributed his success to the fact that the cylinder was thoroughly pre-heated and was covered with asbestos for thirty-six hours after welding. This again seems to indicate that care in preventing unequal contraction on the part of the operator is very essential.

One of the latest applications of welding in railway shops is in welding up flat spots on wheels and on one road, when they run out of material for use in this connection, the large chips from the wheel lathe are used. In another case a Thermit weld was successfully made in two heats, because conditions imposed a limit on the size of crucible which could be used. However, under ordinary conditions, the Thermit people do not approve of such a practice, and it is evident that a weld made in two heats might not prove satisfactory in other cases.

The limit of possibilities in shop welding has by no means been reached as yet, and as the use of the various processes becomes more universal, many new operations in welding will be worked out. It is now being realized that the secret is in having operators who know their work thoroughly, however, and another year or two will see many developments in shop welding.

The Brick Arch

In investigating the objections of those in charge of locomotive design and operation, who do not believe in the use of the brick arch in practically all classes of service and who present their cases in detail, we have invariably found that the troubles recited are those incident to the use of old style arches, frequently of the "home-grown" and undeveloped variety. It is only recently that the proper principle of the use of arch brick in the firebox has been rightly applied. The locomotive brick arch is a boiler accessory that has had the attention of railway motive power men for the last fifty years, yet it is only within the last few years that any decided steps have been made towards perfecting this efficient device so that its use could be extended and made practicable under all conditions of locomotive operation. It is apparent from a study of the history of the subject that there have been but few dissenters from the opinion that the locomotive brick arch is a device of considerable merit, yet in the past many of the locomotive operators have considered it a complication to be avoided. This so-called complication has been avoided by many in years past, simply because it was comparatively an easy matter to avoid or side-step it, but this is not so at present and for various reasons. It is true, in the past, that a great deal of trouble was experienced from the use of brick arches, yet there is no denying the fact that there has always been not only a saving in fuel from the use of a brick arch, but also the brick arch has been the means of eliminating boiler repairs. There are many instances where the brick arch has been the means of increasing the life of flues at least 50%. It is a well known fact that if it is possible to keep the boiler makers out of the firebox it will be the means of increasing the life of the flues. However, with the old style arch, which consisted merely of slabs resting on arch tubes, or an arch supported by studs, when there was any flue work or stay-bolt work it was necessary to remove the entire arch in either case. This was not only an expensive proposition, but consumed considerable time, and ofttimes when the flues really should have had some attention on account of the short time which the engine would remain in the roundhouse, and considering the time required to remove the arch and reapply it with the time consumed by the boiler maker on the flues, it was almost impossible for a first-class job to be done; and consequently the brick arch was looked upon as something to be avoided.

Up to a few years ago there was a great deal of trouble experienced with arch tubes. This is not to be wondered at considering the manner in which they were applied, the diameter of the tubes and the material used. However, today, all these complications, which were the result of faulty designs and material, have been entirely eliminated and it is a rare case indeed where there is any trouble experienced from arch tube failures.

The brick arch saves coal because of the better combustion and because of the baffling and retaining effect on the gases, and on the fine and light combustible material which otherwise would be drawn from the flues in the form of sparks, and partly consumed coal. The brick arch abates the smoke and cinder nuisance on account of the more thorough combustion due to the better mixing effect of the gases and oxygen of the air drawn into the fire box; this is due to the fact that the long flame travel gives more time for combustion to be completed before the gases pass into the tubes and are lost. The baffling effect on the cinders is a thing that can be determined, and numerous tests carefully conducted show a very marked decrease in the cinder throwing due to the baffling effect of an arch.

The brick arch affords a protection to the flues. This statement can be verified by inquiring of anyone responsible for the up-keep of flues who has had an opportunity of observing the difference in this respect between arched engines and no-arch engines.

By the use of a brick arch it is always possible to enlarge the nozzle tips. This is accounted for by the fact that a greater percentage of the gases from the arch are consumed, the brick arch acting as a mixer, the better mingling the gases, aids combustion and results in higher temperature in the fire box. Therefore, by opening up the nozzle, considerable saving in fuel and a more efficient locomotive is the result.

All of the complications which the old style arch had are today past history, as the improved sectional arches which are in use on many roads are demonstrating their worth. With these improved sectional arches the brick can be removed and can be handled very easily. This is true of any of the sections

for either flue work or stay-bolt work, as the ends of the brick do not fuse together, and even if one entire section should be destroyed for either flue work or stay-bolt work, three-fourths of the arch still remains intact, and to replace the entire section, which might possibly be destroyed, the cost would not amount to over one dollar.

A brick arch is the means of making a good fireman out of a poor one on account of the care which a fireman must exercise in placing each scoop of coal on the fire bed. Where no brick arch is used, it is common practice for the fireman to open the fire box door, close his eyes and try to hit the crown sheet, if possible. With the arch, a fireman must fire according to correct principles or he will soon have a bank under the arch which will result in more work for him, thereby teaching him that this is a mistake which should be and can be avoided.

The practice of using mechanical arch tube cleaners is now quite general and should be universal, as no trouble is experienced from scale when a mechanical cleaner is used to cut it out of the tube. Merely washing the tube will not answer the purpose—the scale must be cut out.

The value of the arch tube as a means of better water circulation has not received the attention which it really deserves. Even where arches are not used, arch tubes in the fire box promote higher efficiency in steam production and the only objection to their use, that of higher boiler maintenance cost, has been proved an imaginary one.

In any service the brick arch should be specified, but activity in this direction should not end there or perhaps the results will compare with those which in the past have been responsiblt for prejudice against the practice. There are several designs in arches and arch brick and there are most surprising differences in maintenance cost between the different designs. The subject is of more than sufficient importance to warrant study and tests. It may be found that the use of a brick which is comparatively lower in first cost may be productive of lowest maintenance expense.

The Interstate Commerce Commission.

A year ago one of our ablest writers on practical railway subjects published a strong article calling attention to the fact that the personnel of the Interstate Commerce Commission did not contain a sufficient number of practical railroad or traffic men. The long drawn out method pursued by this body of arriving at a conclusion in the increased rate case seems to have verified this prophecy and opinion. Only last winter, when the present Administration had the names of several men under consideration for appointment to fill the two vacancies then existing on the commission, for the first time two or three representatives raised the question in the House of the advisability of continuing the old policy of appointing attorneys instead of trained railway experts. The objections were futile and half-hearted, as the two attorneys were appointed. The attention of other representatives was called to this inconsistency and also to the article mentioned above. But "stress of other work" precluded the possibility of their either reading the article or taking a stand against the Administration's appointees. Is it not high time that in a commission of so much power and import men who are experts in the sale of transportation be appointed, rather than have it a goal for political reward to lawyers and others who are not especially versed in this science? The decisions of this commission affect almost every industry in this country, as well as the carrier itself, for the cost of transportation directly affects the cost of manufacture and of produce. So do the lack of and delay of decisions.

Someone has stated that one of the recent former administrations was contemplating the appointment of one of the best-known railroad executives of the country on the commission. He consulted with one of his advisers, but was informed that although the man under contemplation would be one of the most desirable to be obtained, he could not afford to give up his large interests and salaried connection to accept an appointment that held forth so little monetary remuneration. If this is the situation, it seems proper that the people demand of their representatives that bills be enacted to make this remuneration sufficient to attract men of the highest known ability in transportation matters.

Is not one lawyer well versed in the Federal law as to traffic regulations and one lawyer familiar with Federal restriction as to the amount of bonds and stocks to be issued sufficient representation of the legal profession on the commission? Should not the remaining membership be constituted of a trained traffic man, a transportation official, a representative of manufacturing interests and possibly a representative of produce shippers? Would not this make a commission more representative of general business and the various branches and affiliations of the transportation business? This should be conducive of efficiency and quicker results in reaching momentous decisions. It would obviate the taking of endless testimony, or at least a great deal of it, that now seems necessary to enable the present commissions to reach a decision. While these deliberations and taking of testimony are progressing, the business of practically the whole country is affected in one way or another.

Within the last week an able editorial writer on one of the conservative dailies speaks of the delay of the Interstate Commerce Commission in passing upon the petition of the railroads for an increase of rates as an indictment of the commission itself. During the fourteen months that have passed since the filing of this petition, shippers as well as railroads have been forced to figure in the dark. In addition to orders from railway supplies and most necessary renewals being suspended, quotations upon commodities and produce have been tentative, because of the inability of manufacturers and merchants to figure the cost of transportation.

Some idea as to the difference in the lengths of service to be expected between locomotive boilers and marine boilers may be gathered from the statement of the fact that the two double-ended Scotch marine boilers of the steamship "Virginia" of the Goodrich Line (Chicago), which were installed when the steamer was built in 1893, are still performing satisfactorily, the pressure has not been reduced by government inspectors and the boilers are still allowed 180 lbs. per square inch. Twenty-one years of service could scarcely be expected of boilers of modern locomotives. Of course it may be pointed out that the conditions are more exacting in locomotive service than in marine service. This is no doubt true, but it does not account for the great difference in the life of the boilers. The boilers

of the "Virginia" are beginning to require "nursing," but conservatively speaking and barring accident, they are good for thirty years. They are fired under heavy draft to maximum capacity while the engines are in operation.

MECHANICAL ENGINEERS MEET IN PARIS.

This year the summer meeting of the British Institution of Mechanical Engineers was held in Paris and the north of France, and concluded on July 10. A most interesting program was drawn up, including the reading of valuable papers, excursions, visits to works, etc. Three of the papers might warrant a little extended reference here perhaps. In his address on some recent development of express locomotives in France, Professeur Edouard Sauvage, having been in communication with the chief engineers of the principal French railway companies, gives an interesting account of the most recent improvements in locomotive construction, chiefly in connection with the boilers. He points out that with the exception of a few of the Atlantic type, all engines built for main line service since 1904 are six wheels coupled, either 4-6 or 4-6-2. Superheated steam is largely used, especially in latest constructions. With a few exceptions Schmidt standard superheaters have been adopted. Owing to the large size of the tubes necessary to receive superheating pipes, it frequently happens that the heating surface is greatly curtailed; and in some engines the total heating and superheating surface is less than the surface which might have been obtained without superheating. No difficulty is reported to arise from the use of superheaters. When the valves and pistons are properly lubricated with an efficient oil they do not give signs of undue wear, even with superheat up to 340 deg. C.

Except in one of the largest companies, all the engines for express service have four cylinders; in a few cases simple expansion is used, but a large proportion are compound. Piston valves are generally used for all cylinders, but flat valves are occasionally used for the low pressure cylinders when the steam is superheated. It is usual to have four separate valve motions, the reversing gear operating the high pressure and low pressure at will, either together or separately. An exception to this is found in the Paris-Lyon-Méditerranee engines. The low pressure valve motion has the same admission (about 63 per cent) backwards and forwards. It is operated by the same screw as the high-pressure motion, but is only transferred from one position to the other when reversing, the high pressure valve motion being designed to cut off steam up to 88 per cent. The starting device comprises only a cock admitting live steam to the low pressure cylinder without any special exhaust for the high pressure.

Summarizing, the author states that the large increase in the power of express locomotives is characteristic of recent construction; nevertheless, a further increase will be required in the near future. Larger boilers have been designed and fitted with superheaters. The conditions in France seem to be similar to those in Great Britain, in both of which countries special experiments as well as ordinary practice have proved that superheat confers an important increase of power without causing trouble or undue expenses. Another point on which experts agree is that superheat alone is equal or even better than compounding with saturated steam. One point that seems open to further discussion is whether superheating and compounding must be superposed: generally French practice as regards express engines is in favor of this supposition, with the interesting exception of the Midi Railway.

Speaking on compound articulated locomotives Anatole Mallet states that the tractive power of a locomotive is equal to the weight on the coupled wheels multiplied by the coefficient of friction. This weight, which was 3 tons per axle on the Stockton and Darlington line in 1825, when railways were first started, has now gone up in the United States to 25 tons and more, whereas the number of axles coupled together has increased from 3 to 6 and even 10. Thus the weight and the hauling power of engines have increased tremendously.

THE RAILWAY EXCHANGE.

(Suggested in a London, England, paper by the appointment of H. W. Thornton of the Long Island R. R., as general manager of an English road.)

I had just retùrned in 1916, from Central Africa after an absence of some years. A few days after I got back I thought of looking up a friend of mine who had been manager of the Great Penzance and Durham Railway.

I called during their slack time, sent in my card, and was received by a tall, angular man with a worried look that wouldn't come off.

"But," I said, with my usual celerity of apperception, "you aren't Billy Pendon."

"No, I guess not," said the angular one. "You asked to see the manager. I'm it, and my name's Hiram H. Hammerum, late of Athens City, Wisconsin. What can I do for you?"

"I beg your pardon!" I said; "my mistake. I thought my old pal Pendon was still boss of this line. Perhaps they've transferred him. I know he had ambitions in the direction of the Great Southern."

"Waal, they must have taken a wrong turning," said Mr. Hammerum. "Cyrus Z. Yonks, late of Paris, Tennessee, has charge of the system you mention. They imported him in 1915, after the first big strike."

"Dear me!" I said. "Never mind, he's no doubt got some big billet with one of the other big lines."

"Say, am I right in assooming that your friend Pendon is an Englishman?"

"Sure," I said, dropping into his vernacular.

"Then," said Hammerum, decisively, "he's not working any responsible post on any English road. I can't say I know all the bosses by name exactly. But I'm durned sure of one thing about them, and that's their nationality. Sir, in this country the managers, assistant managers, secretaries, good superintendents and other prominent officials on our leading roads are exclusively the product of the United States."

He leant back in his chair, tucked his thumbs under his shoulders, and bit on a ponderous cigar, regarding me expansively the while.

"I'm sorry," I said. "I've been out of England and got out of touch with things. But I'd like to find Pendon. What's happened to the Englishmen, anyhow?"

"Them? Oh, they've mostly gone out to take charge of railroads in the States."—*London Opinion.*

CASH INVESTMENT OF THE RAILWAYS DURING SIX YEARS.

During the six fiscal years 1908 to 1913, inclusive, the steam railways of the United States of Class I invested in their road and equipment cash to the amount of $4,010,385,303. Railways of Class I, so designated by the Interstate Commerce Commission, are those with annual operating revenues of over $1,000,000. They include about 90 per cent of the mileage, receive more than 96 per cent of the revenues, and handle more than 98 per cent of the traffic.

This cash investment of the operating railways of Class 1 of the eastern district during the six years was greater than the amount of capital securities issued by them during this period, and was 19.9 per cent of the aggregate of their capital securities outstanding June 30, 1913; of the railways of the same class of the southern district it was 21.1 per cent, and the railways of the same class of the western district it was 23.2 per cent of the aggregate of their capital securities outstanding June 30, 1913. That is, the cash actually expended by these railways during the last six years upon their properties used in transportation amounts to more than one-fifth of their total capitalization at the close of the last fiscal year. This is at the rate of $668,397,551 per year.

These figures are obtained through a compilation made by the Bureau of Railway Economics from the reports of the railways to the Interstate Commerce Commission.

Macon Tool Room, Central of Georgia Ry.

By A. R. Davis, Tool Room Foreman

The tool department of the Macon shops of the Central of Georgia is located in the center of the shop, the workroom in the gallery, with the distributing room beneath connected by elevator.

This location of the distributing room makes the tools accessible to all departments with the least loss of time. The boiler shop maintains a distributing room for special boiler tools and a general line of drills, sockets, reamers, motors, etc.

Tools are delivered by eight messenger boys who answer calls by bells, there being forty call boards throughout the shop, the enunciator being in the distributing room. A bench is provided for the messenger boys, they answering calls, first in, first out.

Many of the heavy special tools are kept in the special gangs using them, to save handling; cupboards being provided for same.

Two men are kept in the distributing room; one whose duties include operating the No. 3 Sellers tool grinder, clamping air hose and truing grinding wheels (twenty-seven wheels) throughout the shop each week, or as needed.

plate, radial drill, and milling machine used for drop hammer and forging machine dies.

While having no turret lathe in the toolroom, a great deal of tool work is done on the turret lathes, they being conveniently located in the gallery.

A Pratt & Whitney surface grinder with a magnetic chuck in the machine shop is utilized for a great deal of work, saving much in milling and in amount of stock used.

The average railway shop maintains the toolroom as a repair department for machines and tools, making only such tools as special requirements necessitate, and requiring mechanics of all-around ability. This policy has not called for well-equipped toolrooms and but few railway shops have equipped toolrooms so that tools can be manufactured economically.

The tool requirements of the locomotive repair shop calls for tools of strong and simple design, the service being severe in most cases, and frequently abusive; the limits of accuracy being liberal.

General View of Macon Tool Room.

Sufficient tools are kept on the racks to supply sharp tools for dull, drills being sent to the workroom for grinding by machine but twice a day. Reamer grinding is handled once a week.

Figure 1 shows the layout of the distributing room. Above the delivery counters, opposite each tool rack, is a sign showing tools on that rack. Each rack has a checking board listing all tools and sizes of the class on the rack. Tools are not required to be returned each night, owing to the resulting loss of time. All tools are required in on Saturday night, however.

Figure 2 shows the layout of the workroom, with the grinding machine at one side, with bench and floor space separating from other classes of machines. The crane shown covers bench, face

In most instances the quantity of small tools required prohibits the use of elaborate jigs for much of the work, the cost of the jig being equal to the saving in labor of two or more years' product.

During the past three years all milling cutters, except saws having less than ¼ inch face, have been made in the shop.

For slab milling, inserted peg cutters, as shown in Figure 3, have given the best service of several types used. This cutter is easily ground, the face having been milled to a true spiral. The spiral cutters shown for milling connecting rod and eccentric blade jaws have also given good results.

Cutters for channeling rods are made with machinery steel bodies and inserted high-speed steel blades held by screws and bushings

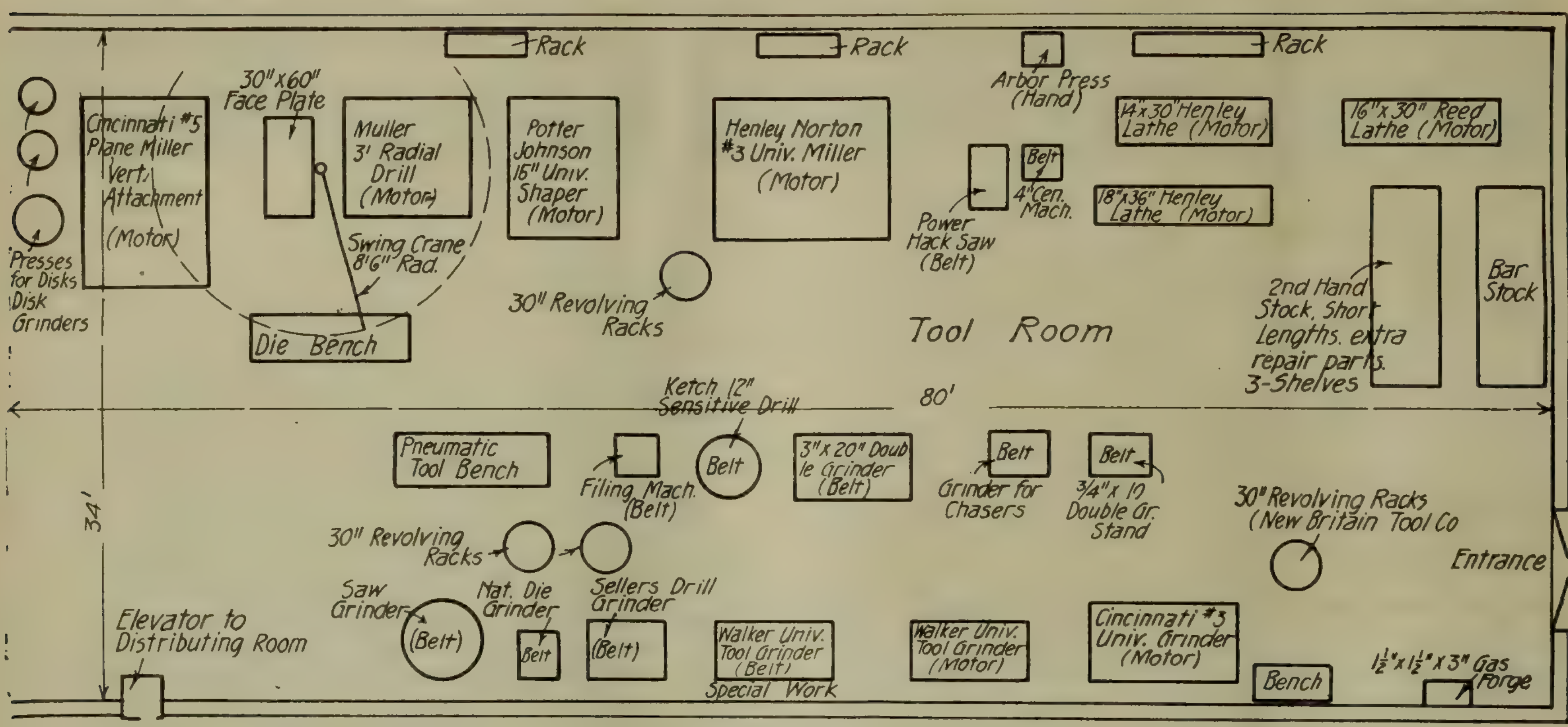


Fig. 2.

having a flat taper side. Radii are ground true with grinding attachment, shown in Figure 4.

In making cutters for milling connecting rod ends on a large vertical miller and the general line of medium size parts milled throughout the machine shops, we have found that solid cutters of high-speed steel, 4" diameter, 2" bore and from 5" to 8" face, having 10 flutes with a spiral angle up to 25 degrees, gives a good output and finish. The solid cutters, whose first cost is practically the same as the inserted type, requiring no special tools or jigs, are smaller in diameter than the inserted types, making them more convenient to use on connecting rod ends and conform to the correct outline of the rods.

By increasing the angle of the spiral the liability of chatter under heavy cuts has decreased. All nicks in cutting edges have clearance. *All milling cutters when ground are tested for clearance with a Brown and Sharpe clearance test gauge.*

Straddle mills up to 1⅛ face by 7" diameter are made solid. The larger sizes, special form cutters for wrenches, etc., are of the inserted type. All fluting cutters are made to suit the shop requirements. End mills are of the coarse flute type, made solid.

Fig. 3. Milling Cutters, Macon Tool Room.

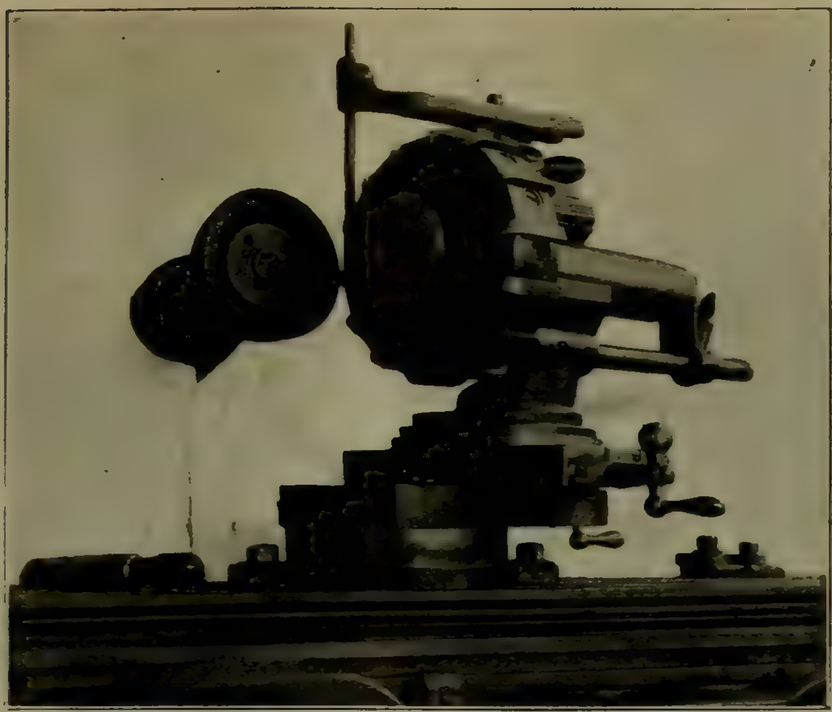


Fig. 4. Radius Grinding Head for Milling Cutter.

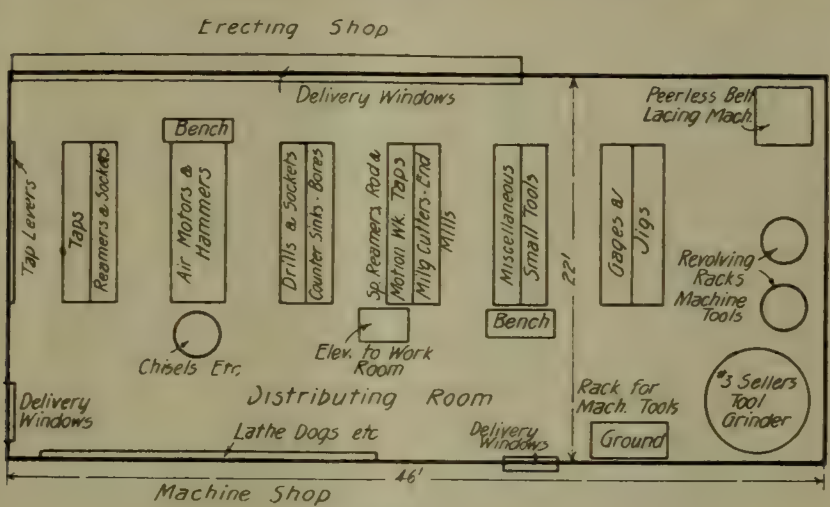
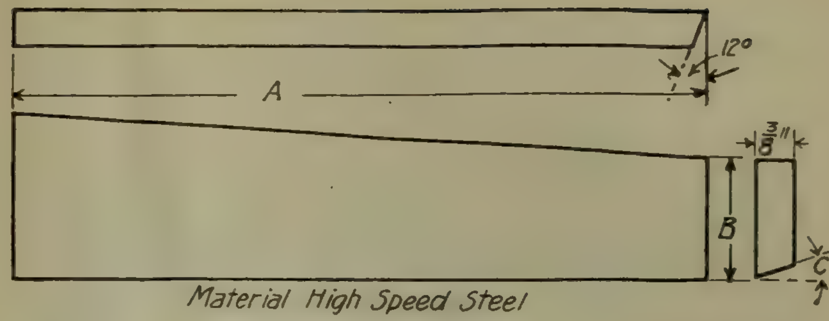


Fig. 1.

The system used for handling engine bolts requires special handling for taper reamers, the holes being reamed to fit the bolts. Bolts are made on a Lassiter bolt-turning machine, and sizes by 32nds of various lengths are carried in storehouse stock. The bolts take sizes from under the head.

The setting up and grinding of the blades for the bolt-turning heads is handled in connection with the grinding of the reamers, the heads being set up to the male gauges and the reamers ground to the female gauges and marked sizes from large end of the taper. See Figure 5. This necessitates a reduction of 1/32 inch for each grinding.

The blades for the turning heads are made in 6", 9", 12" and 18" lengths, as shown in Figure 6, using ½"x5" high-speed steel stock, milling to 13/32" thickness, holding the stock with a 10"x30" magnetic chuck. The blanks are then sawn diagonal to the taper required, held same as for previous operation. The edges are then struck off and bottom end squared. After hardening the sides are ground to proper thickness on a Pratt and Whitney surface grinder, holding with a magnetic chuck. The back is then tried for straightness. The blades are then ground for taper and clearance angle in grinding jig, shown in Figure 7. To get a good product it is absolutely necessary that both taper and clearance be correct.



TAPER .782" PER FOOT

Diam. of Bolt	Length A	B	C- Iron	C- Steel
3/4	6 1/8 9 1/8	1 11/16	24 1/2	
7/8	6 1/8 9 1/8	1 5/8	23	
1	6 1/8 9 1/8 12 1/8	1 9/16	21 1/2	
1 1/8	6 1/8 9 1/8 12 1/8	1 1/2	20	
1 1/4	6 1/8 9 1/8 12 1/8 18 1/8	1 7/16	18 1/2	
1 3/8	6 1/8 9 1/8 12 1/8 18 1/8	1 3/8	17	
1 1/2	9 1/8 12 1/8 18 1/8	1 5/16	15 1/2	
1 5/8	9 1/8 12 1/8 18 1/8	1 1/4	14	

Fig. 6.

Tools handled on the magnetic chuck are demagnetized with a home-made demagnetizer taking up to 3¼" round.

Owing to these conditions it was necessary to modify the lengths of the taper reamers from the standard reamers on the market, the lengths of the flutes being made 6", 9", 12" and 15", that the minimum amount of reaming might true up drilled holes.

Rose reamers 1 5/16" in diameter and over are made with high-

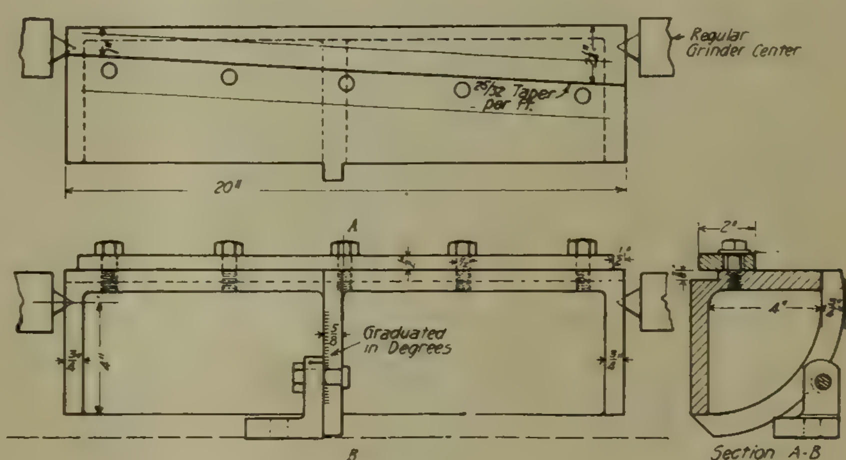


Fig. 7.

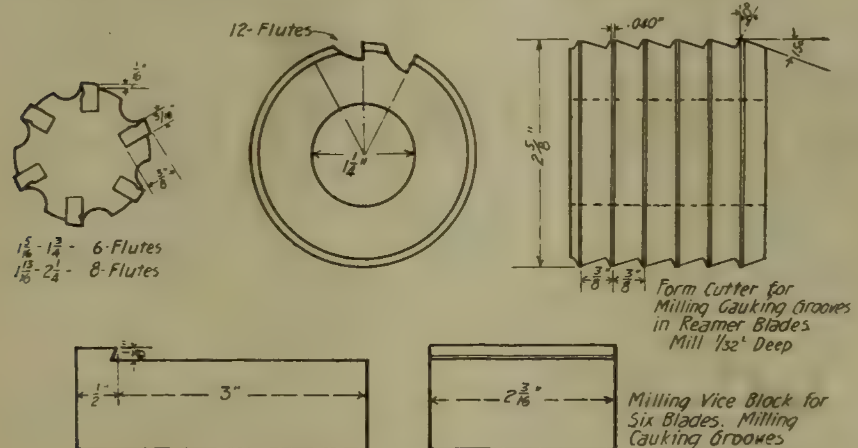


Fig. 8.

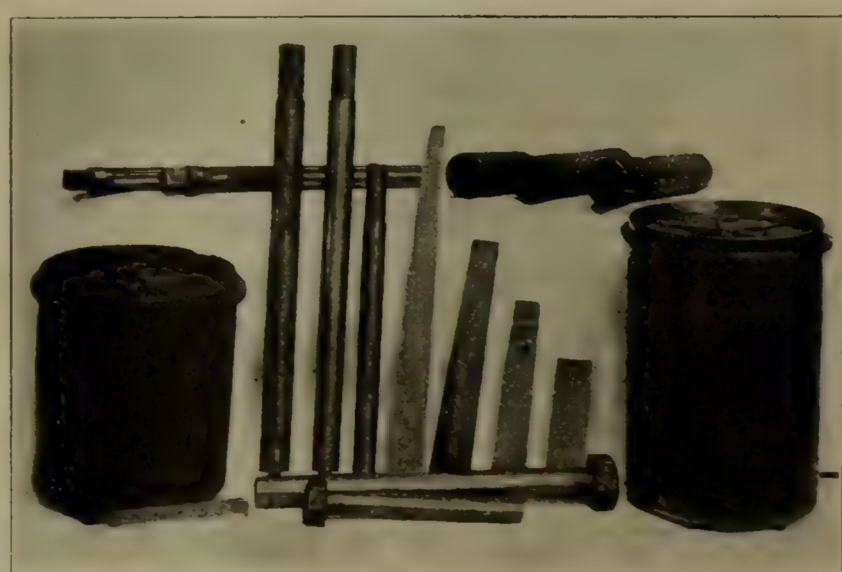


Fig. 5. Bolts, Reamers, Turning Heads and Gauges.

Fig. 9. Special Reamers.

speed steel blades inserted in a .35 to .50 per cent carbon steel body, as shown in Figure 8. The blades are drawn from scrap stock and annealed at approximately 12 cents per pound, ground to proper thickness on the surface grinder, holding with magnetic chuck. After grinding the calking grove is milled 6 per setting with a special cutter, as shown. The tangs are heat treated.

The saving in first cost of the inserted blade rose reamer will vary, with the diameter, from 25 to 65 per cent. When worn to where recutting or new blades are required, the recutting of the solid reamer is the more economical operation, and, taking into consideration the reclaimed value of the solid reamers, the economy of using the inserted blades is greatly reduced.

Special reamers for rod, cross head and piston heads are of the inserted-blade type (see Figure 9), the blades being ground from ⅜" stock to .350" to fit the body and are held with a binding screw at each end. These reamers are handled through the distributing room by number, as shown on list given in Figure 10. The men in charge of the special work have a chart to order reamers from distributing room. These reamer charts are changed each month to cover any changes due to grinding or otherwise. A number of large core reamers up to 3⅞" for special work have been made with 3 and 5 flutes having a 20-degree angle of spiral.

Bolt cutter dies are made from high-speed steel stock ground

CROSSHEAD & ROD REAMERS					
Reamer No.	Taper	Diameters	Diameters	Length	Shanks
1	5/8	2-7/16	3-1/16	12	No. 5 Morse
2	5/8	2-15/16	3-9/16	12	No. 5 "
3	5/8	3-1/8	3-3/4	12	No. 5 "
4	5/8	3-1/2	4-1/8	12	No. 6 "
5	5/8	4-3/16	4-13/16	12	No. 6 "
6	5/8	4-7/16	5-1/16	12	No. 6 "
7	5/8	4-5/8	5-1/4	12	No. 6 "
CROSSHEADS & KNUCKLE PINS					
8	1-1/4	2-13/16	4-1/16	12	No. 6 Morse
8-B	1-1/4	3	4-1/4	12	No. 6 "
9	1-1/4	3-1/4	4-1/2	12	No. 6 "
10	1-1/4	3-7/8	5-1/8	12	No. 6 "
11	1-1/4	4-1/2	5-3/4	12	No. 6 "
KNUCKLE PINS (Repairs Only)					
12	1-1/2	2-1/2	4	12	No. 6 Morse
13	1-1/2	2-7/8	4-3/8	12	No. 6 "

Fig. 10.

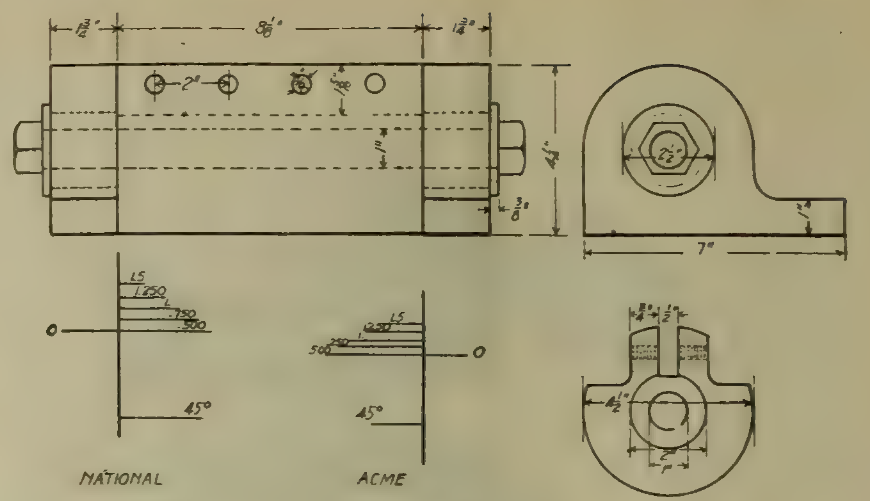


Fig. 11.

to standard thickness and hobbed with a 3 per cent under size hob in a regular bolt cutter head. Figure 11 shows jig used for milling back and face angles of chasers with an end mill. The spacing of set screws on one side being for Acme chasers, the other for National chasers, each side being graduated for the bolt diameters to bring the face angle to the correct angle of rake for cutting wrought iron bolts. All dies for bolt cutters, turret lathes and special staybolt threading machines are ground on a National die grinder, no hand grinding being permitted.

Boiler punches and dies, pneumatic hammer and rivet set blanks, flue rollers, etc., are turned on the turret lathe. Rivet set blanks are drop forged from Vanadium tool steel. Beading tools are drop forged from vanadium tool steel and finished by hand, there being but little hand work to do. Beading tools are required to be gauge and tools exchanged for inspection for each job.

Shear blades are ground with bevel edge on the surface grinder, holding, as shown in Figure 12, to magnetic chuck. Forming tools for planer work are handled in the same manner.

Drop hammer and forging machine dies constitute 20 per cent of the toolroom work and are handled in a group of machines reached by a crane. Blocks ranging from 40 to 750 pounds are used, the product being in proportion. This work calls for many end mills of special shape, many of which are made from short twist drills. Figure 13 shows drop forged tools and wrenches. Wrenches are milled in an adjustable jig to nut sizes plus 1/32".

Reclaiming worn and broken tools is given special attention, utilizing second-hand material where possible. All tools when annealed and bar stock are painted colors to show the grade of the steel, and are kept sorted on racks according to grade and shape. Boiler punches are ground to smaller sizes, milling saws and cutters up to 1¼" face, and straddle mills are ground out in the flute when worn to a broad cutting land; larger sizes are annealed and recut.

The hardening department is located in the smith shop and is operated in connection with the tool department. The layout is shown in Figure 15. A pyrometer and a thermometer registering up to 700 degrees are used. All temper is drawn in an electric-heated oil bath built in the shops and is controlled by a series of switches by which the heat can be regulated within 10 degrees.

The handling of machine repairs requires considerable work and

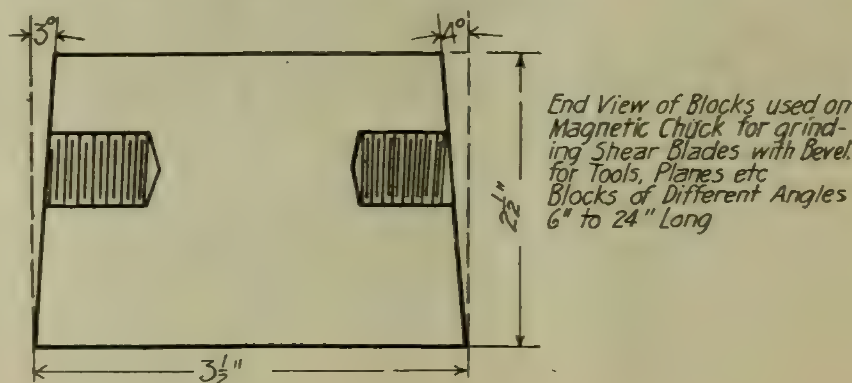


Fig. 12.

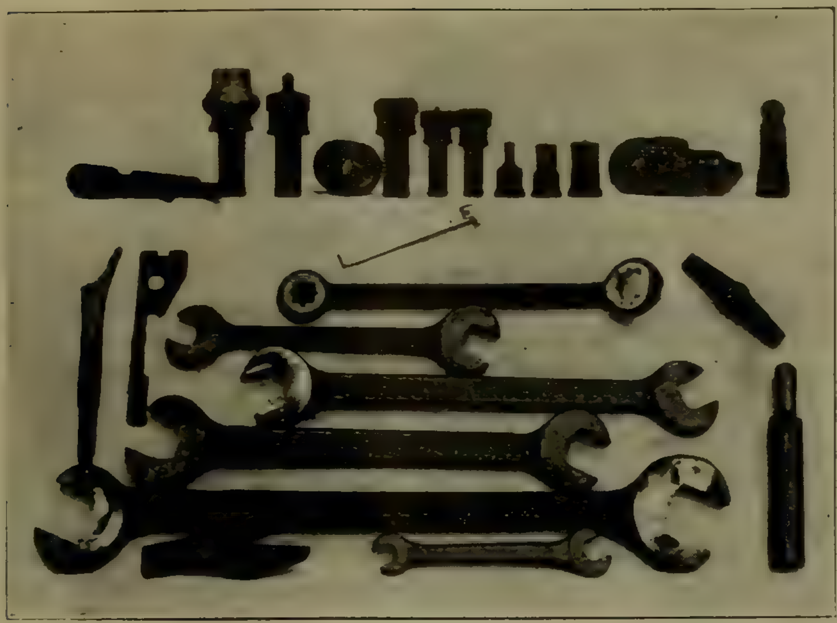


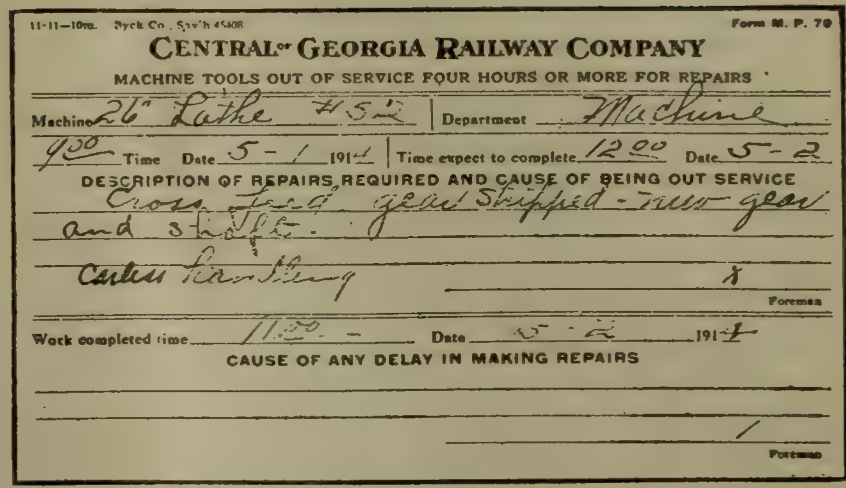
Fig.13. Drop Forged Tools.

frequently interferes with the progress of other work in the tool-room.

To avoid confusion in this work the blank shown in Figure 14 is made out in duplicate, the foreman of department in which the machine is out of service signing original and sending to the master mechanic's office, the other copy being held by the tool foreman until repairs are completed, who then fills out, adding information as to additional work found necessary, sending to the office where the copies are placed on file. In addition to the blanks, the tool foreman keeps a record of the repairs, causes, cost, etc. From this record the following conclusions have been drawn:

The care of the shop machinery is largely up to the foreman in charge of the department, the majority of the workmen caring for their machines only as they are instructed and discipline compels. The causes of failures to shop machinery most common are lack of oil, rough and careless handling, and overloading.

Lack of oil causes more machine failures than all other causes, usually from careless oiling or oil pipes or channels becoming choked.



11-11-10m. Dyck Co., Sav'h 45408 Form M. P. 79

CENTRAL of GEORGIA RAILWAY COMPANY

MACHINE TOOLS OUT OF SERVICE FOUR HOURS OR MORE FOR REPAIRS

Machine 26" Lathe #52 Department Machine

9:00 Time Date 5-1 1914 Time expect to complete 12:00 Date 5-2

DESCRIPTION OF REPAIRS REQUIRED AND CAUSE OF BEING OUT SERVICE

Cross feed gear stripped - new gear and shaft.

Careless handling

Foreman

Work completed time 11:30 Date 5-2 1914

CAUSE OF ANY DELAY IN MAKING REPAIRS

Foreman

Fig. 14. Machine Tool Repair Card.

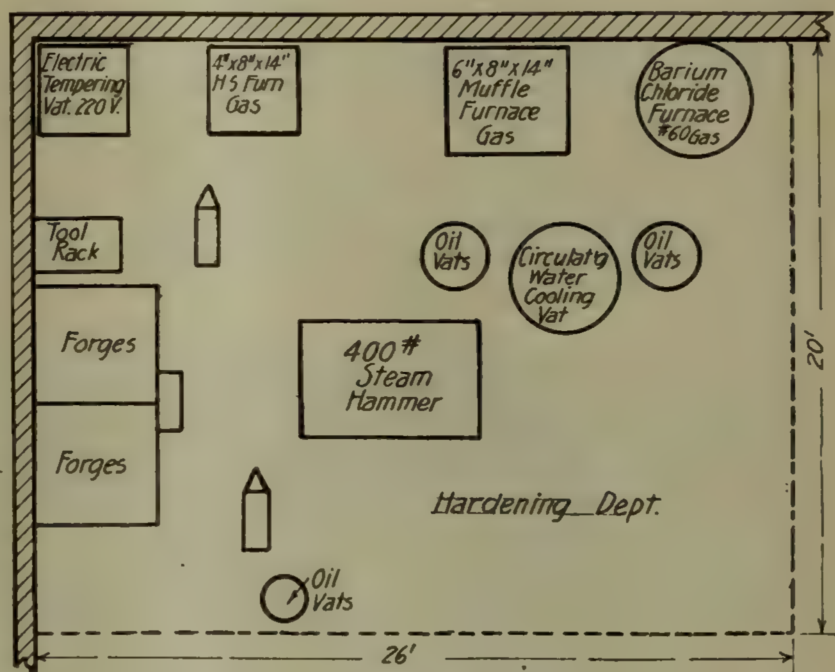
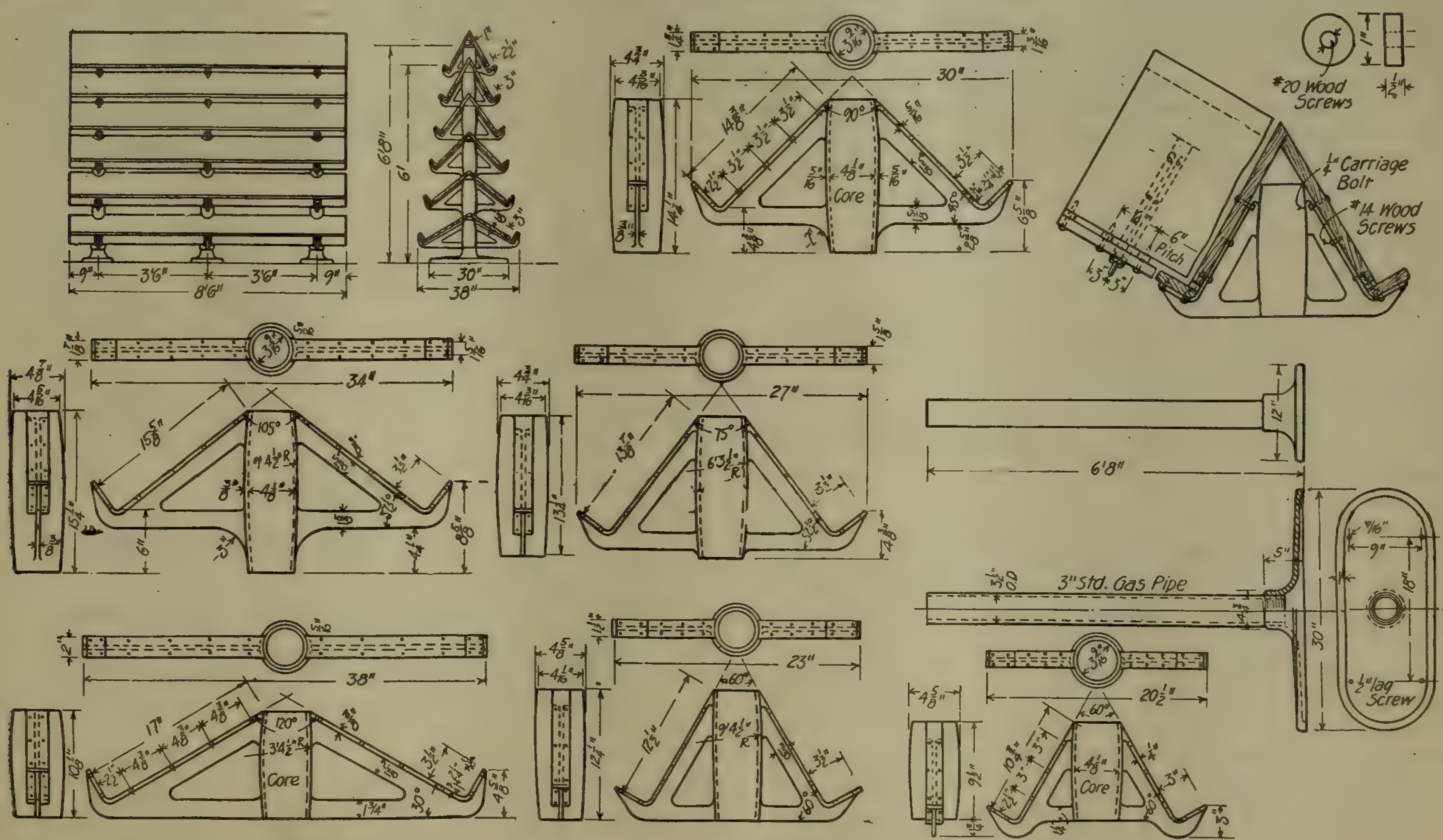


Fig. 15.

Rough and careless handling of machines cause repairs as follows:



Details of Tool Room Racks, Central of Georgia Ry.

Breaking off of screws and small projecting parts from hitting with a hammer or tools.

Jamming lathe carriage.

Jamming heads on planers and boring mills.

Allowing too much overhang to compound rests of lathes.

Using planer tool heads too low.

Giving too much overhang from tool posts.

Not properly clamping work to tables, especially drill presses.

Not seeing that back gearing is properly in mesh.

Allowing chips to fall in working parts.

Allowing bolts or tools to lie in slots of boring mills table.

Lack of instructions to operator of machines.

Overloading of machines is not a frequent occurrence, shearing machinery being the easiest overloaded, the fuses on the electric motor protecting the motor but not the machine, as the momentum of the revolving parts will cause breakage when a machine is jammed.

All punches and shears are plainly marked the diameter of holes and thickness of plates or sizes of bar stock.

The most frequent causes of failure of finished tools are, in drilling, not clamping work properly and lack of cooling compound; in reaming, allowing flutes of reamers to pack and jamming reamer in taper holes; in milling, improper clamping of work, feeding with the revolution of cutter and backing into clamps.

Pneumatic tool failures most frequently are caused from lack of lubrication or by falling from the side of a boiler.

VALVE GEAR DEVICE.

By B. N. Lewis, Ins. Shoreham Shops, M., St. P. & S. S. M. Ry.

A device which does not increase the parts of the Walschaert or similar gears has been developed in our shops to overcome the slow action which the combination lever imparts to the valve. The attachment consists of an arm, bolted to the main rod just back of the cross head, and actuating the combination lever through its connection, displacing the present co-called crosshead arm. This arrangement is the result of an effort to overcome the slow starting of trains and maintainance of speed by engines equipped with that type of gear.

The combination lever requiring one-half the movement of the crosshead in order to overcome lap and lead has a tendency to slow the action of the valve gear as ordinarily connected with the crosshead arm.

The heavy constant lead, required at short cut-offs in order to maintain sufficient port opening where little opening other than that transmitted by the combination lever is given to the valve, causes too early a preadmission of steam at maximum cut-off and decreases the starting power of an engine so equipped.

The main rod arm in addition to receiving the usual crosshead motion, also receives a supplementary motion. This is accomplished by being directly connected to the main rod.

The crosshead connection at point "A" figure 1, moves in the same line of motion as crosshead pin "B" but with connection on main rod this point "A" receives the same oscillating movement that the main rod does from its pivot, point "B," causing it to move forward and back of point "B" a distance of two to three inches, depending on the proportions of the arm.

The greater part of this supplementary movement is transmitted to the combination lever as the crosshead approaches to and recedes from the ends of its travel, and in turn gives it an entirely different movement of that derived from the crosshead connection.

A full conception of the device may be had by referring to figures 1, 2, 3.

It will be noted (Figure 1) that the crosshead is approaching the forward center and the main rod is in an inclined position, the arm being rigidly attached to the main rod, its bottom end or combination link connection is the same degree back of the pivot point "B" that the main rod is above it. The combination lever being connected by means of the combination link to the bottom end of the arm, has its action delayed in the same proportion.

The events of release, compression and pre-admission taking place in this part of the stroke, are delayed proportionately with the delayed action of the combination lever.

The crosshead having reached the end of its travel (figure 2) in this position, the main rod is in the center of the oscillatory movement derived from the wrist pin "B" and no movement being transmitted to the combination lever other than that given by the crosshead, the combination lever is therefore in the same position it would occupy if connected directly to the crosshead.

Lead is therefore not affected by the use of this device.

The crosshead now having started on its return stroke (figure 3) the main rod is passing its pivotical center is again in an inclined position and has moved the bottom end of the arm ahead of the position it held in relation to the crosshead while on the center and in so doing has delayed the return movement of the combination lever.

The advantages gained are, later release and compression, less pre-admission, a quicker, larger and longer maintained port opening with the same cut-off. Uniform valve events allow the use of a shorter cut-off with its consequent saving of steam. This fact, combined with the longer maximum cut-off develops a more powerful and economical locomotive. This device was developed by Messrs. Kingan and Ripken and has been applied to thirty engines on our lines. It has proven very satisfactory in the three years of its service.

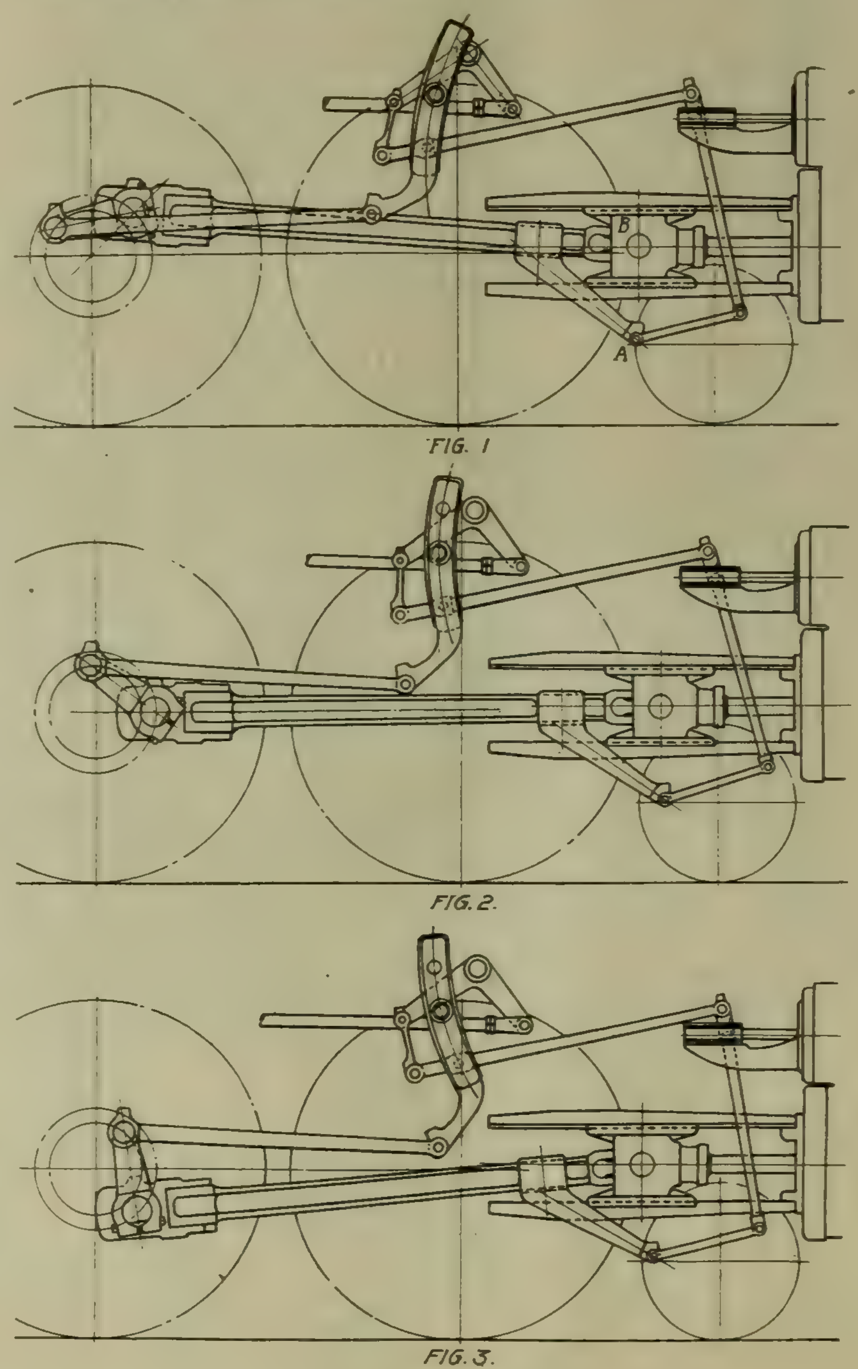


FIG. 1

FIG. 2.

FIG. 3.

Valve Gear Device.

All-Steel Box Car, P. R. R.

In 1912 the mechanical engineering department of the Pennsylvania Railroad designed a box car having an all-steel underframe, posts and braces, which supported a wooden lining and floor. All of the steel parts being on the outside, the interior presented a smooth wooden surface.

Continuing the policy to ultimately obtain an all-steel box car, a new design is now under construction, which is known as the X 25. The car is of 100,000 pounds capacity and is equipped with 5½" by 10" arch bar or crown cast steel side frame trucks. The inside length is 40' 5"; width 8' 10", and the height is 9' 1", giving a cubical capacity of 2,343 cubic feet. The height of floor from rail is 3' 7½". The eaves are 9' 2" wide at a height of 12' 10". The length of the car over end sills is 42' 6", and the extreme width is 10' 1$\frac{7}{16}$" over side doors, the door opening being 6' 0" wide and 8' 5¼" high.

The underframe of this car is of the same general type as used in recent Pennsylvania design; viz., the weight of the superstructure and lading is transferred to the center sills by means of two pairs of cantilevers or crossbearers, and the end construction, thus eliminating the use of a body bolster.

The backbone of the underframe has a minimum section area between rear follower stops of 34 square inches, and is composed of 2⅜" fish belly type center channels with 4" flanges top and bottom, the channels being 20" deep between crossbears, and taper to 11" at a point 22$\frac{11}{16}$" back of the center plate. A 26" by ⅜" cover plate is riveted the full length of the center sills, and a 4" by 4" by ¾" angle riveted to the bottom of each sill on the inside and extending continuously between back draft lugs, which are incorporated in the center plate reinforcing casting.

The center construction is also reinforced at each end by a cast steel striking plate and front draft lugs combined, a cast steel center plate reinforcing casting above the center plate, a cast steel spreader at each point where the crossbearers are fastened to the center sills, and by pressed spreaders between all intermediate diaphragms. The crossbearers on either side of the center of car are composed of two dished diaphragms of ⅜" thickness, having 3½" flanges, top, bottom and ends. The diaphragms are set 5" apart and are joined together at the top and bottom by 1" by ⅜" cover plates, which extend across the center sills and are riveted to the crossbearer flanges. The crossbearers are secured at one end to the web of the center sill and at the other end to the bottom member of the side truss.

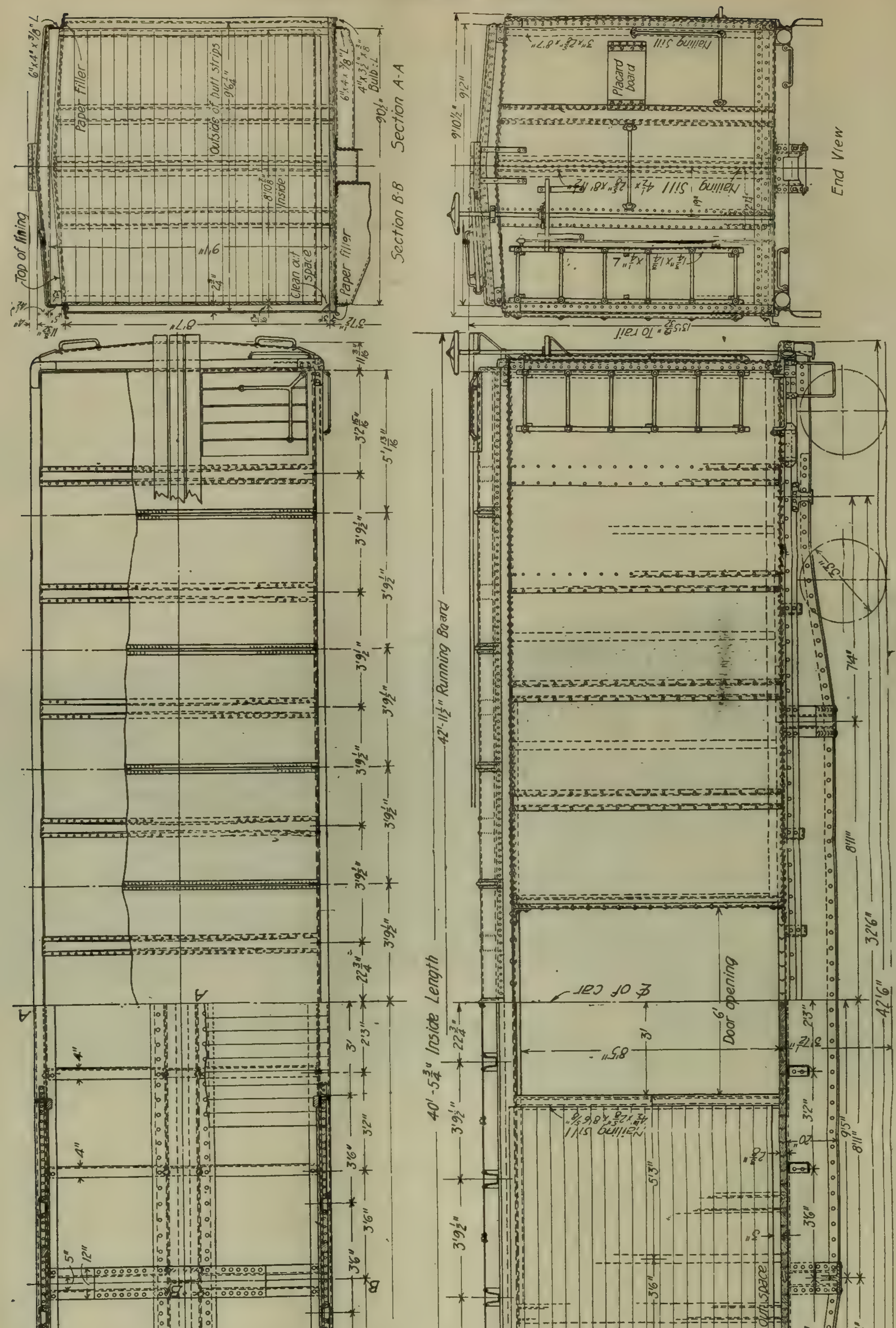
At the center plate the usual body bolster is replaced by a much lighter bathtub type of diaphragm, ⅜" in thickness, 7" in depth, and 7⅜" in width, which is riveted to the center sills and side truss. This is made possible by reason of the fact that this member has to take care of the side bearing thrust only and does not carry any of the load. Above the side bearing, which is a steel casting, is a cast steel reinforcing block, and at the extreme end is a combined roping iron and jacking casting. The drop forged center plate is secured to the flanges of the center sills, as well as the center plate reinforcing casting, which extends back toward the center of the car 9" from center line of center plate, and thus possesses the added feature of reinforcing the center sills at the critical point, due to buffing stresses.

Pennsylvania All-Steel Box Car.

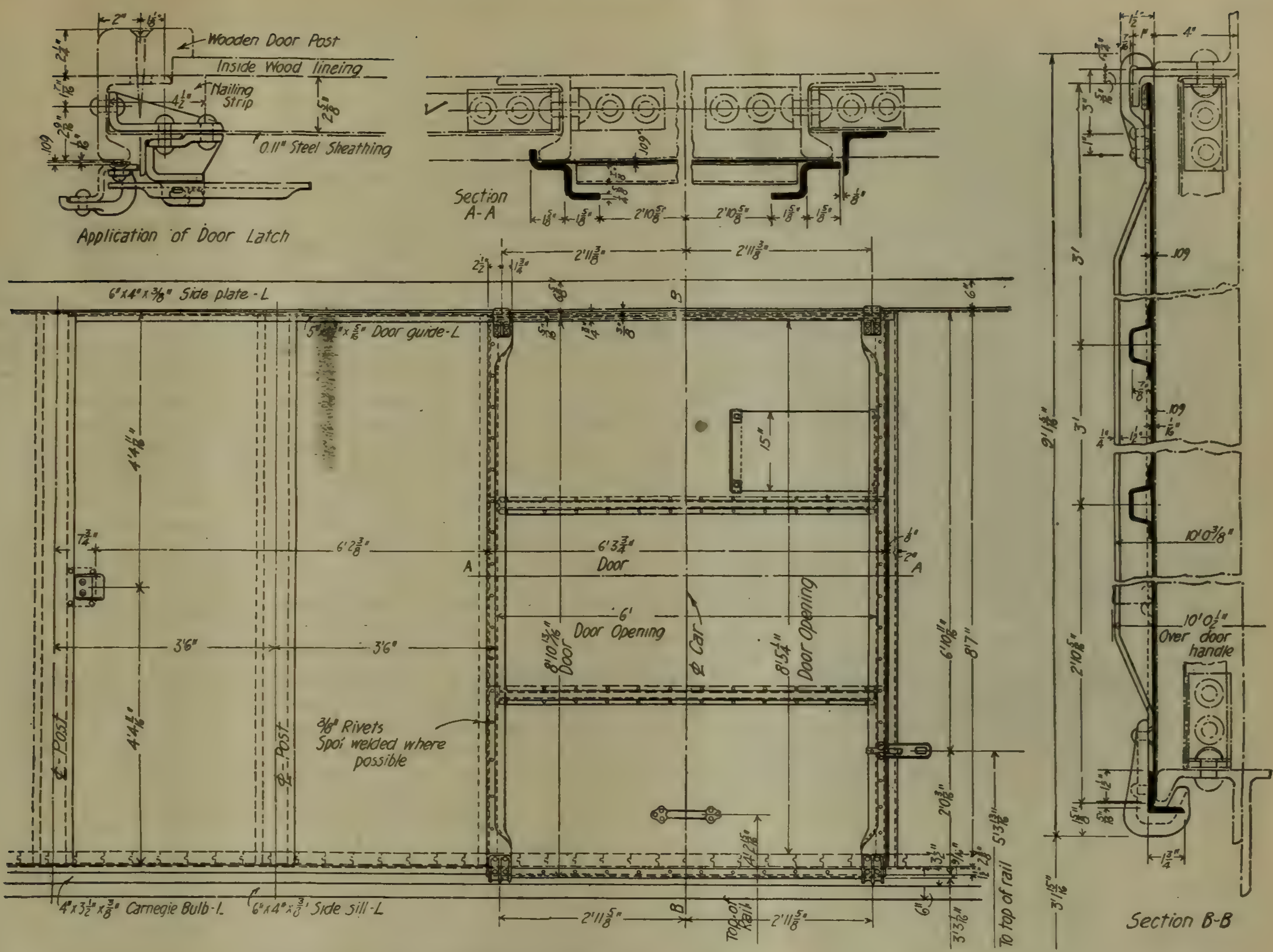
There are six intermediate diaphragms on either side of the car, four of which are located between the crossbearers and one midway between the crossbearer and center plate at either end of the car. The diaphragms, which are 6¾" deep and ⅜" thick, do not carry any of the load as their top flanges are ¾" below the bottom of the floor. They simply act as stiffeners for the bottom member of the side truss, and as support for the brake rigging.

The end sill consists of a Z-shape plate ⅜" in thickness, which extends the entire width of the car, binding the side and end construction together, and is 5" below the top of the center sills. It is flanged inward for a distance of 8$\frac{7}{16}$" at the center, narrowing somewhat toward either side. The back vertical leg, which is 8" high, makes an excellent attachment for the end construction.

The end sill is secured at the center to the striking plate and at either end to a cast steel push-pole pocket and corner casting, which are in turn riveted together and secured to the bottom member of the side truss and to the diagonal brace, while the top vertical leg of the end sill is riveted to the end sheets the



General Arrangement of Pennsylvania Box Cars.



Arrangement of Side Doors, Pennsylvania Box Cars.

entire width of the car. This construction of end sill fulfills all requirements of one of the most important features of freight car construction, namely, finish, strength-binding all continuous parts of the underframe together, and accessibility for repairs.

The diagonal brace is a U-shaped section 8" wide and ⅜" thick, with 2½" flanges pointing downward. It is flattened out at both ends, being fastened to the top flange of the center sills at one end and to the push-pole pocket and bottom side truss at the other end, and thus, by virtue of its position, transferring horizontal strains from the end sills and bottom side truss to the center sill.

The bottom member of the side truss or side sill runs continuously between the end sills and is composed of a 4" by 6" by ⅜" angle and a 4" by 3½" by ⅜" bulb angle, which are riveted together back to back. The short leg of the angle pointing towards the center line of car, and the long leg of the bulb pointing outward, both legs being in the same horizontal plane as the center sill cover plate. These combined sections make an ideal combination for a car of this type of underframe, making an excellent support for the floor, there being no other longitudinal member, giving lateral stiffness to the underframe and a convenient member upon which to secure the side sheets.

SUPERSTRUCTURE

The object aimed at in designing the X 25 car was to provide as great a protection as possible for the lading in case of an accident or rough usage, and to reduce, as far as possible, the number of parts. Therefore, the superstructure was designed with an outside shell composed of a series of ⅛" sheets for the side, and ¼" sheets for the ends, in which the posts were pressed integral with the end and side sheets. A U-shaped post is pressed into one end of each sheet and is overlapped by the adjacent sheet, which acts as a coverplate for the post and gives to the outside of the car a smooth surface. The post part of the sheet is 2¾" deep and 4" wide at the back. The sides of the car are composed of ten sheets each, which have a 2" flange, top and bottom, by means of which they are secured to the bulb angle of the side sill and to the 4" by 4" by ⅜" eave angle at the top, the short leg of which extends outward and along the leg upward.

The end construction is similar to that of the sides, each end being composed of three sheets, the two nearest the sides of the car containing the depression which forms the post. Where the central sheet overlaps these, they are depressed ¼", making the outside face perfectly smooth so that it may fit down snugly behind the end sill. The middle sheet has an additional U-shape stiffener at the center 2⅝" deep, 9½" wide and ¼" thick, which extends vertically from the end sill to the eave angle.

The side door posts are 4" by 3½" by ⅜" bulb angles, extending from side sill bulb angle to eave angle, being securely riveted to both.

The side and end sheets are tied together by a cover plate, L-shape in section and ¼" thick. This is capped top and bottom by suitable castings, which finish off the corners, and at the same time act as a connection between the side and eave angles and the side and end sills. To the side and end sheets, midway between the posts, vertical nailing strips are secured, to which the lining is nailed in a horizontal position.

The carlins are of the bathtub type, being spaced 3' 9½" apart and resting on the 6" vertical leg of the side eave angle and extending downward from the side a sufficient distance to be securely riveted. The $\frac{3}{32}$" steel roof sheets are continuous

End View, Pennsylvania All-Steel Box Car.

across the car, being spot welded to the carlins, which are located in their center. This allows the butt joint to come midway between carlins, with the exception of the end roof sheets, which, by virtue of the position of the last carlin, must cover one and one-half spaces.

The roof sheets are flanged down on the vertical leg of the side and end eave angles 2½″, and are secured to the same by ⅜″ rivets spaced 4¾″ apart. Between the roof sheets and the eave angles are $\frac{3}{16}$″ washers, through which the rivets are driven. This construction allows for a slight ventilation and yet is small enough to keep out any foreign matter which might damage the lading. The roof sheets are fastened together by an outside and inside butt strip. The outside strip is pressed up in the center ⅞″, which adds to the stiffness of the structure, and is 2½″ wide and $\frac{3}{32}$″ thick. The inside strip is 2½″ wide and $\frac{3}{16}$″ thick. These strips are continuous across the car and are riveted to the roof sheets with ¼″ rivets 1½″ apart. To insure a perfect water-tight joint, tar paper is placed between the outside butt strip and the roof sheets. The end and side eave conditions are the same, except there is no ventilation at the end. The roof is equipped with an 18½″ running board, latitudinal extensions and grab irons—all securely fastened to the roof sheets. The 13/16″ pine inside lining is nailed to the vertical nailing strip conveniently spaced around the sides and ends. The lining extends from within 3″ of the floor to a height of 8′ 5″. Since the posts and nailing strips, which are 2⅝″ deep, are all vertical, it will be seen that there is a vertical air space back of the lining, which will allow for ventilation, and also facilitate cleaning, which at times becomes necessary on double-sided cars, due to the lading falling through damaged lining. The application of a triangular grain strip around the edge of the 2⅜″ tongue and grooved floor, next to the side sheets, allow all foreign matter to work its way out from behind the lining.

A new feature in this car is the manner in which the safety appliances are secured. All grab irons are fastened to castings by means of a slotted hole in the face, which permits the removal of the grab iron bolt, and thus the renewal of the grab irons without disturbing the inside lining. A like provision is made for the side door stop.

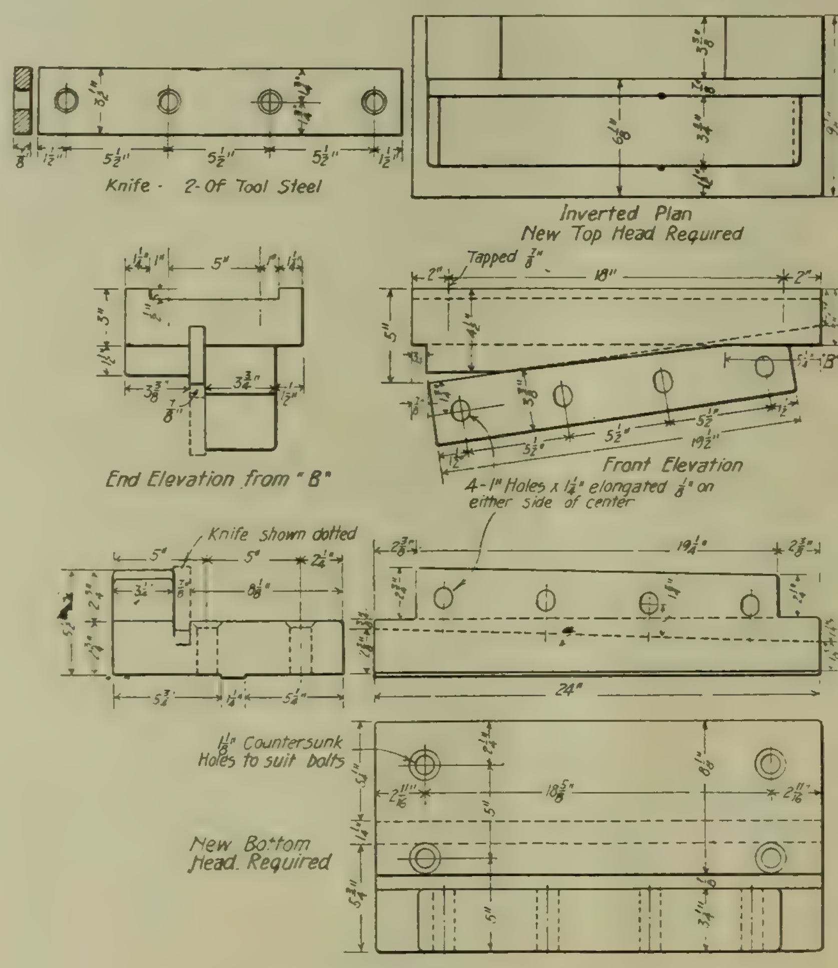
DOORS.

The car is equipped with outside hung doors, being supported at the top by hangers at both corners. A 5″x1¾″x$\frac{5}{16}$″ angle acts as a top guide rail and weather strip, the short leg being turned down over the face of the door. The door is made of .109 O. H. S., with two vertical Z-shaped edge stiffeners, which are flattened out, top and bottom, supporting the door hanger and door guide castings. The rear stiffener laps over the door post and the front one butts against a 2″x2″x¼″ angle riveted to the side sheets and projecting slightly beyond the door, thus forming a weather strip, front and back. There are two horizontal U-shaped sections pressed in the end of the top and intermediate door sheets, which overlap the adjacent sheets, forming a box-like stiffener across the door. At the bottom of the door is a 1¾″x1¾″x¼″ stiffening angle, which runs continuously between vertical stiffeners. The inside of the door is perfectly smooth, all rivets being countersunk. A clearance of $\frac{1}{16}$″ is allowed for door to clear door post. The floor is extended through door opening, flush with the door post, and is supported by the bulb angle of the side sill.

SHEAR BLADE ECONOMY.

By E. T. Spidy, Assistant General Foreman, Canadian Pacific Ry.

An item involving considerable expense in the course of a year in large shops is repairs and renewals of shear blades. Most all our large machines have shear blades that are wide at one end and narrow at the other, giving only one edge to shear on, so that when this edge becomes worn it has to be repaired or renewed. We have effected an economy in this direction by providing our shear machines with new heads that accommodate a rectangular blade that is symmetrical about the bolt holes in every respect. This allows of using all four edges of the blades both top and bottom, making each blade of new pattern. We are in consequence cutting our steel bill for blades in four and getting equally satisfactory results, to say nothing of the labor entailed that is saved into the bargain. The accompanying illustration shows the necessary drawings required to effect this change on one machine.



Knife Heads for Shears.

General Foremen's Convention

The International Railway General Foremen's Association held its tenth annual convention at the Hotel Sherman, Chicago, on July 14, 15, 16 and 17, 1914. The president of the association, W. W. Scott, presided. Leo Hornstein welcomed the members to Chicago on behalf of the mayor and a response was made by W. T. Gale. Following this, President Scott gave his address, in which he advocated that the number of men on committees be increased to ten and that the committee subjects of 1914 be retained for the 1915 convention. He also recommended that the subject of "valves, cylinders, cross-heads, pistons and guides" be made to cover erecting, bench and machine work and urged a closer relationship between the General Foremen's and Tool Foremen's Associations.

The convention was then favored with an address by F. A. Delano, president of the Monon, who spoke briefly on scientific management. He defined scientific management as an effort to eliminate waste.

Engine House Efficiency.

The following is an abstract of a very complete paper on this subject by W. W. Smith (C. & N.-W. Ry.):

An increase in engine mileage is equivalent to increasing the number of locomotives in through freight service. The operating department by co-operating with the mechanical department can do much to increase engine mileage. Trains are oftentimes too long on the road due to poor train dispatching or overloaded engines; engines are delayed to and from the train yards and the engine house; engines are delayed by yard forces not having trains made up; and oftentimes trains come in or are ordered out in bunches, so that the engine house organization cannot handle the engines in the manner they could if the trains had been properly spaced. Hot boxes and drawbars pulled out are another fruitful source of delay to trains on the road.

Good judgment in shopping engines for repairs, and storing them during dull periods is an important item to be considered. While it is not economy to limit engines kept in service to a point that might delay freight, on the other hand it is uneconomical to have engines needlessly lying ready for service. In storing engines, those should be kept in service whose mileage comes nearest entitling them to a shopping. If poorer engines are stored, the good ones are being worn out during the dull season.

There is undoubted economy in long runs for passenger engines, even though they are more conducive to engine failures. When locomotives in passenger service are on long runs, the running repairs are somewhat less per mile run and per car hauled, the oil and coal account is slightly less, and the cost of maintenance of the added number of engine houses is saved. In order to make long runs a success, locomotives must receive very careful attention at engine houses. By the use of stoker and oil feed engines, it is possible to make still longer runs.

A system of regular assigned engines has been inaugurated on some of the divisions of the Chicago & North-Western Railway, with very gratifying results. With this system all engines in through freight service on one division must be of the same hauling capacity, and in equally good condition, so that they are suited for a fast freight one trip and a drag the next trip. The runs are pooled—that is, regular engines are not assigned to certain runs, but an engine crew with a regular engine will take any run that their turn on the board entitles them to. Of course, with this system, more engines are required, as it is necessary to hold engines for the crew's rest, and one or two extra engines are required so that a regular crew can be furnished with a locomotive when their regular engine is held in for work.

In turning engines at terminals, the most valuable units of power should be given the preference—that is, when several different classes of engines are used in freight service. Also the ash-pit tracks should be arranged so that engines not requiring washing out, or other heavy work, can be run around those requiring washing out. It often happens that engines are held in the engine house for work, or for other reasons, until they cool off, and thus considerable time is consumed in getting them steamed up again. Where a hot water fill-up line is provided, a considerable saving in time can be made by letting water out of the boiler and refilling with fill-up water which is nearly at a boiling temperature. When it is the custom not to fire engines until they are ordered, this method is also of advantage, as it is sometimes difficult to get engines steamed up quickly with cold water.

The engine house foreman should always be in a position to quickly and accurately advise the transportation department when he expects engines to be ready for service. Then a definite prospective figure should be given to the yard master two hours before the engine will be ready, from which figure the engine should be ordered. When the engine house force knows that an engine has been ordered on a prospective figure, they will make a special effort to have the engine ready.

It is the practice on some roads for enginemen to get their engines out of the engine house. When this custom is followed there are more apt to be delays. It should be the duty of the turntable operator or his assistants to keep posted on the time that engines are ordered, and see that engines get out on time.

The aim of the engine house management should be to keep engines out of the shop as long as possible, having due regard to excessive lost motion and injury to track due to worn tires. It is probably best to compute locomotive costs on a ton mile basis so there will be a tendency on the part of master mechanics and others to keep engines in 100 per cent efficiency as long as possible, and then when it proves impracticable for the engine house to further maintain at their full hauling capacity to shop them. As an average figure for all roads, freight locomotives do not make more than 40,000 miles between shoppings, and passenger engines not more than 80,000-100,000 miles. It costs on an average about $2,000 to give an engine a general overhauling so that a considerable saving is made by prolonging the life between shoppings. Occasional records of very high mileage have been made, and indicate what can be accomplished by care in construction, maintenance and operation of locomotives.

Just what repairs should be made in the engine house and what should be made in the back shop is a question that must be decided to meet local conditions. But ordinarily it is considered good practice to expend 60 per cent of the maintenance costs in the engine house, to insure best road service, and 40 per cent in the shop.

Too frequently the shop and engine house do not work in harmony. The condition of engines, which are received from the shop after repairs, are often not what they should be; proper attention is not given so that the possibility of very heavy repairs in the engine house is avoided, and so that engines will be in condition to turn as quickly as possible, without the necessity of heavy repairs that would cause delays. There are many things, while an engine is stripped down in the back shop, that can be done for about one-third the expense they could be done for four or five months afterwards.

There are unlimited possibilities for saving fuel at the engine house. Cylinder and valves blowing, cylinder cocks and relief valves that do not seat, leaky whistle and pop valves, leaky boilers, steam leaks in the cab, improperly drafted front ends, bushed nozzles, etc., are all sources of waste that are caused by imperfect maintenance. The care of boiler jacket and insulation and covering on steam pipes and cylinders is also important as the radiation from uncovered surfaces causes losses not to be neglected. Then there are direct losses of fuel at engine

houses due to tanks being overloaded, to uneconomical methods of firing up engines, to engines popping off on cinder pit track while waiting to have fire cleaned, to engine fired too long before they are ordered, etc.

Each engineman should have an individual tool box, which together with the oil cans should be removed from the engine at the end of the trip by the supply man. Engine cushions should be securely fastened to the seats, and suitable boxes or racks should be provided in the cab for lanterns, emergency signals, etc. In order that each fireman may have his own shovel, a suitable rack should be placed in the engine house to which shovels may be chained and locked. Electric headlights are advantageous, in that the trouble incident to keeping up oil headlights and gauge lamps is done away with.

On several roads, at important terminals, a system of relief engines has been adopted. With this plan a relief crew is engaged in taking engines to and from the engine house and yard, and the regular yard engine crews do not come to engine house with engines. When an engine that is working needs to come to the engine house to have fire cleaned or for work, the relief crew brings out a relief engine and exchanges it for the other engine.

The protection of engine houses from fire is a matter that deserves earnest consideration. In the first place there should be a sufficient number of hydrants within easy reach of all buildings, and an outfit of hose should be stored in suitable hose houses in strategic locations. The location of these hose houses should be indicated by red lights. Furthermore, the fire roads and passageways should be kept open at all times. Then there should be a fire company organized with engine housemen, and a suitable code of fire signals should be arranged.

The fundamental principle involved in getting good engine house service is the individual interest of every employe concerned, and the co-operation of all. Probably no other one thing can do quite as much to reduce the net earnings as friction or ill will between the operating and mechanical departments. The closer officials of the two departments get together, the better will be the results. The master mechanic or foreman should call up the train dispatcher the first thing in the morning and help him to line up things, thereby heading off probable failures, and in return receiving valuable information for his department.

The basis of efficiency of a locomotive terminal is time, and everything should be arranged with this idea in view. To obtain the best results in saving time between the yard and the turntable, the engine house should be as near as possible to the yards and connected up with suitable tracks so that the necessary running back and forth can be done independent of the main line; also there should be separate tracks used for incoming and outgoing engines. And the tracks over which the coal and sand are brought in, and the tracks over which the cinder cars from the ash pit are handled, should not in any way interfere with the incoming and outgoing tracks for engines. Suitable crossovers should be provided so that outgoing engines can undergo the same operations as incoming locomotives. At the point on the incoming track where the crews leave the engines there should be track room enough to prevent a blockade in case engines come in faster than they can be handled. And there should be a penstock at this point so that in case of an engine coming in short of water it will not be necessary to switch it around the others. Furthermore, the arrangement should be such that when the hostlers take charge of engines they will receive coal, sand, water and have the fire and ashpan cleaned, without any switching and on a direct line. Arrangements should be made so that it is possible to pass one engine around the others ahead, so that certain engines can be given the preference. There should preferably be four tracks leading to the turntable from the cinder pit—two for incoming and two for outgoing locomotives—so that in case of derailments there will be another track to use. Then in connection with the outgoing tracks, suitable storage tracks should be arranged so that when house room is needed engines ready for service can be stored.

The cinder pit is the critical point in the locomotive terminal, and this is especially true during severe winter weather. It should be located as close as possible to the turntable, and large enough so that a sufficient number of engines can be handled at the same time. The hand-operated cinder pit is still largely used due to its low first cost and reliability, but from the standpoint of economy the submerged type, having an overhead traveling crane with a grab bucket, must be considered. With the latter type the cinder pit stands practically full of water at all times, and into this the cinders are dumped. Then by means of the grab bucket the cinders are loaded into cars. The economy of this method of loading cinders may be judged by the fact that at one of the recent terminals where this system is employed one man working during the daylight hours only is able to load all the cinders, when about 120 engines are handled daily. Furthermore, with this system, all liability of damage to cars from loading hot cinders is eliminated.

The water cranes should preferably be of the balanced, self-draining and non-freezing type. Tank storage is also an important matter to be considered. There should be sufficient tank storage so that in case of accident to the pumping station the supply of water will hold out for at least twelve hours.

The turntable should be long enough so there is some leeway for spotting engines. Several of the recent terminals have been equipped with turntables 100 feet in length. Electricity is the most satisfactory power for turntables, and the installation should be such that the liability of failure is reduced to the minimum.

A hot water washing and filling system is almost a necessity in any important engine house. Not only is there a considerable saving in the time that engines are held out of service for boiler washing with this system, but there is the added advantage of increasing the life and improving the condition of the boilers themselves. A blowing down line should be included in the system, and it should have a capacity sufficient to empty a boiler with 180 pounds pressure in not more than 30 minutes. Washout water should be provided for washing out with a pressure of at least 100 pounds, and at a temperature of about 150 degrees. Then the filling up line should furnish water at a temperature of about 190 degrees. The disadvantage of most washout systems is that no cold water line is provided, and if a locomotive that is fired up in the house runs short of water, the engine must be taken outside, or the tank must be filled with water which is too hot to be worked by the injectors. In order to overcome trouble from this source, some engine houses have been piped with a three-inch cold water line. It is also advantageous at times to fill the tanks of engines before they leave the house, so they will not have to stop outside for water.

In order that engines may be steamed up very quickly at times, a good blower line is absolutely necessary. The steam should have a pressure of at least 100 pounds, and the blower line should be drained automatically with a trap, as there is always more or less condensation in the line. It is very essential that locomotives are fitted with a house blower connection. Some roads provide a connection on both sides of the engines, but the general practice is to use a connection on the left side only, with a standard blower ell and cap or with ordinary pipe connections. The most satisfactory house blower connections are those that have a shut-off at the smoke box, so that it is unnecessary to close blower valve in cab to make or break the connection.

The drop pit section of the house should be from 100 to 112 feet long, so that engines can be spotted in any position with the doors closed. An improved drop pit jack has recently been introduced, which makes it possible to drop wheels more conveniently than before. With this jack the hydraulic ram is operated by means of an air engine, so that no pump operator is necessary. In engine houses where it is the custom to make fairly heavy repairs, a drop pit should be provided for dropping

the entire engine truck in the pit, so that repairs can be made to male casting, cylinder frame bolts, etc.

Locomotive maintenance costs continue to rise, but when we make allowance for the increase in wages, the increased cost of material, and the added complexity of the modern locomotive, the cost of repairs per unit of work has been actually decreased. The practice of standardizing many parts of the locomotive, particularly those requiring frequent repairs or renewal is general, and results in reduced maintenance costs. When parts and castings are arranged to be used either right or left the costs are still further reduced. Then as far as possible all parts should be so constructed and placed that they can be readily removed and replaced; otherwise repairs will be far more expensive than they would have been, had the parts been more accessible.

The present trend of design is characterized by refinements in detail developed with a view of reducing the cost of maintenance. One prominent feature of this kind is the long main driving box of the Cole design, which seems to be the most effective step so far taken to overcome the tendency of the modern locomotive to rapid wear and accumulation of lost motion in the main driving journals. Another new feature of design with a view to the greatest efficiency from the standpoint of maintenance, is the introduction of thrust collars fitted to the axles of the engine truck and bearing against the inside of the journal boxes, thus reducing the wear on the wheel hubs and boxes. Each thrust collar is made in two halves, bolted together and fits up against a shoulder on the axle. Lateral wear may be easily taken up by babbitting the face of the thrust collar. In order to provide for the easy removal of engine truck oil cellars, the truck binders are now sometimes made in the form of links and held in place by finished pins fitted with cotter keys. Thus by simply dropping the pedestal cap link the cellar can be taken out from the bottom. Lost engine truck cellars have contributed a great number of engine failures in the past, but when thrust collars are used in connection with pedestal cap links, it is next to impossible for an engine truck cellar to lose out. The front extension of the piston rod, outside steam pipes, screw reverse gear, and the self-centering valve rod guide are other features of design which assist in reducing maintenance costs and improve operation. The new engine truck with a constant resistance centering arrangement should also be mentioned, as it has very good guiding qualities, and tends to prevent flange wear on the drivers. Another recent invention is an interchangeable driving box or engine truck cellar, which can be packed without the necessity of the removal of the cellar bolts.

Driving boxes and wedges are the most important points to be considered in the upkeep of locomotives. The full shock of the steam pressure has to be met and sustained at these points, and when the wedges or brasses are loose or worn the pound that results soon reduces the rest of the machinery to bad order—even sometimes resulting in broken frames that require expensive repairs. The main boxes are subjected to the most severe service, as they receive the thrust of the main rod directly, with a tendency to move the main journal forward and back in the bearing. This movement is only partially transmitted to the front and back boxes, due to more or less lost motion in the side rods. Driving boxes cannot always be taken care of in the engine house, but the careful maintenance of wedges will do much to keep driving box brasses and rods in good shape. In order that driving box brasses may be maintained in the engine house and without the necessity of dropping drivers, driving boxes with removable brasses have been adapted as standard by the C. & N.-W. Ry. The brass is held in place in the box by a taper wedge, and it is only necessary to lift the weight of the box from the journal and pull the key when a brass is to be changed.

Lateral motion in drivers, trailer and engine truck wheels is one of the hardest problems to contend with in the maintenance of locomotives. When engines are allowed to run with considerable end play, maintenance costs will run up considerably, as it has a detrimental effect on the machinery, and a fruitful cause of breaking frames and straining boilers; also tires are sometimes loosened, brick arches are dislodged, and the flanges of driving boxes are sometimes broken. Furthermore, lateral motion has a detrimental effect on the track, firemen experience difficulty in placing the coal in the firebox, and rod failures occasionally result from the stresses set up by the end play springing the rods out of alignment. With some designs of engines the front side rod collars strike the guides when the lateral in the front drivers becomes excessive. Lateral motion cannot be taken up in engines as ordinarily constructed without dropping the wheels and removing the boxes from the journals. Hence as a rule end play is not taken up in drivers unless engines are shopped for general repairs. The use of bronze hub liners results in the less rapid accumulation of lateral, but on divisions where the track is crooked, the lateral often becomes excessive before engines are entitled to a back shop overhauling. In order that end play may be taken up in the engine house without dropping the wheels, and without holding engines from their runs, a box has recently been introduced with removable lateral motion plates with babbitted faces. These removable plates can be used on engine and trailer truck boxes, as well as on driving boxes. They have been adapted as standard on several roads. As an aid in taking up lateral in engine trucks, it is the custom on some roads to babbitt both sides of engine truck boxes when engines are undergoing repairs, so that in the engine house it is only necessary to turn the boxes end for end to take up the lateral.

With the marked increase of weight and power of locomotives, the tire mileage has decreased, but by use of improved heat treated and Vanadium steel tires, the mileage has been increased in some cases. Vanadium steel tires should be expected to give nearly twice greater mileage than the ordinary carbon steel tires.

Sand traps and operating devices on engines should be outside of the box, so that they are easily accessible for repairs. The secret of getting good service from sanders is the careful attention given to the piping. Fifty per cent of the sand failures are due to split and loose pipes not pointing to the rail. Air leaks in the pipes prevent the accumulation of sufficient pressure to blow out obstructions, and in some cases moisten the sand in the trap around the end of the nozzle.

With the large Mallet, Santa Fe and Mikado type engines now in use, injectors are often required to supply as much as 150 gallons of water per minute, when engines are operating at full capacity. Hence the need of maintaining tank valves and siphons, feed and delivery pipes, injectors and boiler checks, in good condition. The location of boiler checks on the top of the boiler is probably the best from a maintenance and operating standpoint. Engines should be equipped with some good form of feed water strainer so that fine particles of coal which wear injector tubes and check valve seats, can be removed.

Without question the successful operation of air brakes, sanders, injectors, lubricators and blowers depends largely upon the piping. In the first place all piping should be securely stayed and clamped; otherwise it is impossible to prevent leakage and breakage. A new system of clamping has recently been developed, whereby the pipes are held rigidly in place by suitably located castings, which are in most cases attached to the boiler.

Copper pipes sometimes give trouble by wearing through where they come in contact with the sharp corners of metal cabs and running boards. In order to prevent trouble from this source, it is the custom on several roads to enclose the copper pipe at the exposed places with iron pipe of larger size. In some cases oil pipes have been thus enclosed the full length of the engine, and when thus protected need never be removed from under the jacket for repairs. To overcome the trouble experienced with brazed joints, a mechanical joint has recently been devised which is coming into quite general use. With this joint

the copper pipe is rolled into the sleeve, much the same as a flue is rolled in the flue sheet.

The systematic use of blow-off cocks in connection with soda ash treatment result in greater life of the flues, longer periods between washouts, decreased scale formation and fuel economy. The following rules should be observed in the care of boilers at terminals:

When fires are being cleaned or dumped, the blower should be used only sufficiently strong to prevent smoke from emitting from the firebox door.

The fires of all engines awaiting service should be banked at the front flue sheet.

Unless absolutely necessary, injectors should not be used while fires are being cleaned, or when there is no fire in the firebox, nor while locomotives are being used on their own steam, without first brightening up the fire.

Rapid and accurate locomotive inspection is a matter of the greatest importance from a maintenance standpoint. Where the most satisfactory results are attained, inspection is made by a force of special inspectors who have been trained to inspect certain parts of the engine. This practice is followed at some of the important division points on the Pennsylvania Railroad. The head inspector examines the outside of the engine and fender, and looks at trucks, wheels, draw gear, brake rigging, couplers, grab irons, footboards, pilot steps, and all safety appliances. He gauges the couplers for height, wear of knuckles and heads, examines the knuckle-lock pins, etc. He examines driving wheels, flanges and tires, main and side rods, brasses, knuckle pins, crosshead pins, crossheads and guides. He looks for loose pipes and clamps, oil cups and lids, cracks or breaks in frame, working of cylinders, missing or defective safety pins, and examines the valve gear, springs and spring rigging. He reports hot bearings, leaky washout plates or plugs, or any other defect that may come under his notice. He has charge of the other inspectors and sees that each inspector makes out a report for each engine inspected.

Another engine inspector starts in under the pilot and examines the truck, wheels, frame, braces, axles, boxes, stiffening pieces, driving boxes, shoes, wedges, pedestal caps valve gear, eccentrics and straps, and oil pipes, cup lids, draw gear between engine and tender, spring chambers, buffer casting, ash pans, dampers, grates and grate rigging, and underneath the tender he examines trucks, center castings, wheels, frame and side bearings.

The head air brake inspector examines the brake valve, air pump, gauges, and governors, noting dates on tags. He reports them for attention after 30 days from the date on tag. He examines air pipes and reservoirs above the running board to see that they are tight and properly secured, the sanding devices, gauge glass and gauge cocks. He is required to try them and blow them out. He notes the condition of the fire door, the apron and foot plate, washout plugs, sprinkling hose, etc. He examines the throttle gland to see if the packing will last until the engine is due for washing. When a boiler is due to be washed he calls attention to the need of throttle packing, if such be the case, and also if any valves in the cab need packing. His most important duty is to examine the crown and side sheets for leaks and to note the condition of the flues. This examination is made in the presence of the engineer and before he goes off duty. This inspector also examines the staybolt and boiler washout tags, notes when the engine is due for staybolt test or boiler washing, and keeps a book record of same. When an engine is due for staybolt test or boiler washing, he chalks the steam chest so the hostlers know that the fire has to be knocked out.

One duty of the head air brake inspector on roads equipped with track troughs is to lower the water scoop while the man underneath gauges it, to see that it is neither too high or too low. This man underneath is also an air brake inspector, and he examines all air pipes, hose and connections below the running board, brake rigging of engine and tender, notes the piston travel and locates leaks of every description.

The steam heat inspector examines all valves in the cab and at the rear of tender, all joints and pipes between engine and tender, and on front and rear. He tests the governor to operate at 100 pounds, and reports any leaks or defects in the portion of the equipment for which he is responsible.

When these examinations have been completed, from four to five minutes being sufficient, each man writes his report on the proper form, and sends it by pneumatic dispatch tube to the engine house office. By this means the reports covering the condition of the engine reach the work distributor's desk almost as soon as the engine reaches the ash pit.

DISCUSSION

W. F. Lauer (Ill. Cent.) found that the assigning of power cut the locomotive supplies in half, and L. A. Hardin (C. & N.-W.) also reported in favor of assigning power. Quite a number of the members were opposed to the pooling system. C. B. Hitch (B. & O.) said that the lack of organization was the secret of terminal delays, and in this opinion he was supported by W. T. Gale (C. & N.-W.). A monthly inspection and a change of air pumps every six months was believed by W. G. Griffith to have eliminated many failures on the Pere Marquette. There was some discussion as to what constituted engine failures on various roads. L. A. North (Ill. Cent.) thought that the cost of general repairs shown in the paper ($2,000) was a little low for the heavy power now in use and that it should be about $2,700. At the Burnside shops staff meetings are held once a week and the subject of economies is always a prominent one. H. O. Warner (L. S. & M. S.) is now handling engines on piece work and where he used to have five men to handle the engines he now has one. There was some discussion also on roundhouse fire departments.

J. S. Sheafe, master mechanic of the Baltimore & Ohio at Clifton, S. I., gave the association a very interesting talk Wednesday morning on the relation of the general foreman to shop efficiency, in which he emphasized the importance of good organization and considerate treatment of subordinates at all times. Thought, said Mr. Sheafe, is what the general foreman is getting paid for.

Valves, Cylinders, Crossheads, Pistons and Guides

An abstract of a paper on the above subject by T. J. Mullin (L. E. & W.) is given herewith:

Piston valves on superheated locomotives should be examined once every thirty days, as we find a great amount of carbonization occurs from high temperature, which they undergo due to the oil used and the water evaporated, while passing through the superheated units, finally arriving in the valves and cylinders.

We find that in order to gain the speed power and the saving of steam, coal and water, that piston valves with the Stevensons valve gear should be set in the negative lead to gain the greatest efficiency of the superheated locomotives. In setting the valves in the negative lead, that the high temperature of the superheated locomotives attain, the required cushion or back pressure as formerly acquired by our saturated locomotives. We find that for passenger service ¼" at 25% cut-off, freight service ⅜" at 50% cut-off makes a very economical setting for both class of service.

Valves of all types of locomotives when shopped should be examined and put in first-class condition. Slide valves seat should be faced and slightly spotted. Valve strips should be fit in valve grooves and strips spotted to the friction plates. Spring should be properly adjusted so there is not enough friction to wear grooves in friction plates. But enough to overcome any chance for steam to escape and cause a blow. Piston valve and valve chambers when worn 1/32" should be bored, and new valve rings should be perfect fit to valve chamber and should be 1/32" larger than valve chamber. Old rings reapplied when in shop

or in engine house should be at least $\frac{1}{16}''$ larger than valve chamber.

Piston valve chamber heads should be kept in first-class condition so as to overcome steam leaks. Cylinder should be rebored when worn $\frac{1}{16}''$ out of round and should be bushed when not over $\frac{3}{4}''$ larger than the original size. Front and back cylinder heads should have perfect joints.

On engines converted from saturated to superheated locomotives, the cylinders have a tendency to crack from the valve chamber to the receiving ports of the cylinder. In order to overcome this we are applying a cross-brace from front to back of it between the valve chamber and the cylinder, shrinking the same and drawing the metal together in order to hold it when under the high temperature of superheated steam and by doing this have overcome the cracking of this part of the cylinder.

Piston heads should not be allowed to become more than $\frac{1}{8}''$ smaller than the cylinder; cylinder packing should be fitted to the cylinders; we believe that the Dunbar type of cylinder packing is the most economical for the length of service and less wear on our cylinders. Pistons should be examined every shopping as we find that in some cases they are apparently O. K. until examined and in many cases we find they are worn flat. Some we find are checked, by chalking or whitewashing these parts will show check and cracks in piston rods.

Piston bearings in heads and crossheads should be, in our opinion, a taper of $\frac{3}{4}''$ to $12''$. Piston packing. All joints should be ground, packing properly fit to cup and rods, springs and retainers measured and made proper lengths and sizes. By doing this we can overcome one of the steam leaks as required by federal law.

DISCUSSION

W. W. Scott (D. L. & W.) gave it as his opinion that removing relief valves on superheaters was the best practice, and another member stated that a good dose of kerosene oil helps to prevent carbonization. T. J. Mullin found it good policy to examine packing once a month, as enginemen usually couldn't tell what the trouble was. A method of repairing cracked cylinders on the Chicago & North-Western was described. This had been in use about five months and had effected a great saving. W. F. Lauer spoke very favorably of the Layden packing in use on the Illinois Central.

A. P. Prendergast, superintendent of machinery Texas & Pacific Ry., favored the convention with an address Thursday morning. A very apt statement in his address was, "It is not the things we do that absorb our energy but the things we don't get done."

Practices and Methods of Maintenance and Repairs to the Air Brake and Its Appurtenances

Portions of this paper by C. N. Newman (A. C. L.) follow:

The maintenance of the air brake depends largely on five principles:

Accessible location of parts which require frequent attention; proper installation; methods of inspection; to what extent we make terminal repairs; methods and practices of making repairs to the principal parts.

It is a fact that when time is short and many repairs are to be made that the parts most accessible will receive the attention and those inaccessible will be neglected. This results in lowering the efficiency of the brakes, in neglect of equipment and, after all, an increase in the cost of maintenance. I have seen air pumps located so close to the running boards that it was next to impossible to remove the bottom head or a valve cap without removing the pump or the board.

Pipe unions are sometimes located so that it is necessary to loosen, perhaps, several clamps, and possibly take some part down in order to tighten them. Very often you will find brake cylinders so located, especially on locomotives, that it is necessary to remove it from its frame in order to apply a leather or gasket.

The air pump should be made perfectly secure at its location, and so located that the intake will not be in a position to get all the dirt and grit from the running boards or ashes from the pans when fires are being cleaned or dumped. The air pump steam pipe should be connected to the boiler so as to insure dry steam at all times. A good lubricator pipe connection is a great help to the proper operation of the pump. Reservoirs and other parts which have several pipes connected should be fastened to some place as free from vibration as possible and the fastening made securely, as improper installation and location of such parts are responsible for a great many leaks and broken pipes.

When installing an air brake equipment or any part of the equipment, there are several very important facts to bear in mind:

First—Locate parts convenient for the repair man and the air brake operator.

Second—Do not place parts, whose efficient operation is affected by heat, too close to the boiler.

Third—Locate parts with pipes connected at a place free from vibration.

Fourth—All parts must be free from any foreign matter before application.

Before any engine leaves the engine house its entire air apparatus should be given a thorough inspection and test by competent men, and all perceptible defects corrected. The air pump should be given an efficiency test to satisfy that it is capable of supplying the necessary quantity of air under ordinary conditions.

A thing which is very frequently overlooked by inspectors, especially on locomotives, is—are the brake levers, beams and hangers the correct ones for this type of engine? Frequently a repair man, at an outside point, will replace one of these with one of the nearest to correct that he has. This lever may increase the braking power and under unfavorable conditions would cause wheels to slide, or he may have decreased the braking power by applying a light beam or the wrong hanger, which has reduced the efficiency of the brakes.

I believe as good method of inspection as could be installed is to follow a plan of having the brake tests and inspection made on arrival of trains, making subsequent disposition of cars with defective brakes, which, to repair, would require more time than allowed, and having the formal test made with the departing engine, which should not require any more time than to make the test and inspection, and, possibly, stopping a few leaks in the hose couplings.

At the very best, the regular terminal tests of brakes on engines or cars misses many of the defects, and for that reason, it is important that as few defects as possible be allowed to escape repair. However, it does not follow that the repairing of defective brakes cannot be done without delay to cars which should go forward promptly.

By assigning a certain track in important terminal yards for air brake repairs, which require more time than the ordinary repairs made on the service tracks, and a few men with the necessary repair materials, such cars are often repaired and go forward in the first train out, and very few are allowed to go forward without repairs being made.

All cars in shops or on repair tracks with cleaning dates over nine months old, should have their brakes cleaned and lubricated. Not only will the condition of brake cylinders and triples fully warrant this, but it is improbable that these cars will be so favorably located again for months, without causing delay and switching.

When triples need cleaning, it is not a good policy to do this on the repair or service tracks, but they should be removed and sent to the shops, or some place fitted with a test plant, so that, after the operation of cleaning and lubricating, they can be placed on the test rack and given the required test;

then they are ready to be replaced on the car or engine, and efficient operation is assured. To handle triples in this manner does not necessitate the purchase of a large supply of extra triples, for if all triples are removed from the bad order cars (which every road has a supply of stored for heavy repairs) and cleaned, lubricated and tested, you will find you will have an abundance of extra triples which can be used to replace those sent to the shop for attention. This removal from the "B. O." cars is not an extra expense, as they should be cleaned and lubricated before going into service from the repair yards.

When the triples are being removed from "B. O." cars or engines, the air and signal hose should also be removed and applied to other equipment in service, as the rubber hose deteriorates very rapidly. By doing this, the life of the hose is obtained in service.

A common defect which is frequently let pass without repairs is brake cylinder packing leathers. A high priced brake equipment is of no service if the cylinder leathers are not in condition.

Since the introduction of the large and compound pumps, which are to take care of the increased train, most of us have been using this increase of air to take care of our air leaks, which is not only hard on the pump but expensive from a fuel standpoint. Just for the sake of illustration—

A certain large railroad system, which operates long trains successfully, has an allowable maximum train line leakage as follows:

For trains from 25 to 50 cars—7 lbs. per min.;

For trains from 50 to 75 cars—6 lbs. per min.;

For trains from 75 or over—5 lbs. per min.

Our average train is from 50 to 75 cars; the allowable leakage on this train is 6 lbs. per min., or about 65.5 cu. ft. of free air, which is about the capacity of our single stage 11" air pump. Suppose to operate an 11" air pump, we require 200 lbs. of coal per hr. or 4,800 lbs. for 24 hrs.; estimate coal at $2.00 per ton—it would cost $4.70 to pump against a 6 lb. leakage for 24 hrs. Suppose we were handling 36 such trains, these leaks, in fuel alone, would amount to a waste of $169.20 a day.

Autogenous Welding

We have the electric and oxy-acetylene plants installed at Macon (Cent. of Ga. Ry.) shops. We have done quite a lot of welding with them both, but at this writing I am not in a position to give a comparative cost or the efficiency of the two methods mentioned. We at first installed the oxy-acetylene plant and used this method altogether, and about two years later we installed the electric. Shortly after the electric outfit was going, we had an accident occur to the acetylene plant. We then had to resort to the electric for all classes of welding. We have just about completed our new acetylene plant and have made a few tests on side sheets with the electric and oxy-acetylene. One of our greatest troubles is breaking in operators and holding them on the job after they have learned to handle the torch successfully. Each craft does the welding of metals that originate in their respective departments—blacksmiths handle all wrought iron, steel and cast steel; boilermakers all boiler plates and flues; machinists on cast iron; and coppersmiths get all the brass and pipe work.

One great defect is that its use appears too easy, and it is applied in all sorts of ways. The operators, as a rule, give it but little study, which is responsible for practically all failures, as the average mechanic, these days, devotes but little time to study on the things pertaining to his trade. A blacksmith of the right calibre would, in my opinion, be the right man to handle the welding, as he has more knowledge of heating metals, taking care of expansion and contraction, whether or not the metal is overheated, etc., than mechanics from other departments. At any rate, whoever is put on the job should have a competent instructor, and should be furnished with all the reading matter that is published from time to time on the subject, so as to familiarize himself with the work.

Autogenous welding has enabled the railroads to reduce the cost of repairs, increase mileage of flues, prolong the life of fireboxes, reclaim worn parts of locomotives, repair broken parts of machinery, and number of other savings. As I see it, all large shops, to have a complete arrangement, should have them all.

A field in which electric welding has proven very successful and profitable, is that of welding flues to back flue sheets. We have in service today over 90 locomotives with flues welded to back flue sheet, making a total of about 27,000 flues. Out of this number of locomotives in service with flues welded, we have our first engine to fail on line of road with flues. We have, however, had some few flues to leak after being in service a short while, which was due to bad beads on flues when welded in. If part of bead is off, exposing copper, it is very difficult to get a good weld.

Our first experiment on flue welding was tried out on engine No. 1616, a 21"x28" Pacific type engine. This engine was shopped May 22, 1913, for new back flue sheet. The sheet was so badly worn and buckled that it was impossible to keep flues tight. As we had just installed our electric welding plant we were anxious to see what could be done along this line. Flue beads and sheet were thoroughly cleaned with sand blast, given a light working, and welded in. This engine was put back in service June 1, 1913, and to date has given no trouble leaking. During this time hydrostatic test was applied and no leaks developed. This job was done at a cost of $14.68, where new flue sheet would have cost about $150, and engine held out of service at least thirty days.

It is an easy matter to get the full life required by law out of a set of flues when welded in, thereby increasing flue mileage, reducing cost of maintenance, eliminating overtime in round house and on line of road, and at the same time reducing flue forces in shop.

When new flues are to be welded, we apply them in the usual manner, with copper ferrules, roll bead and prosser. A heavy bead is built up in welding to flue sheet. This leaves a rough finish. Some roads, I learn, shape up beads with a cutter, while others go over them with a beading tool to smooth over. We find this is not necessary, thereby saving this extra expense. The time welding 2" flues will average 14 per hour. In a few instances the operators have welded as high as 21 flues per hour. Out of the number of engines mentioned as having flues welded in, only one full set and parts of three sets have been removed.

Where flues are to be removed that have been welded in, it only requires a few hours longer to cut off beads. And we found that flue sheet is in better condition than before welding in flues, as welding builds up sheet around flue holes to about the original thickness. We have a tool for facing off rough surface after flues are removed, making a good clean sheet for applying new flues.

Welding in half side sheets and patches, repairing mud rings, etc., have proven very successful and profitable with the electric process.

Quite a lot of welding with the electric outfit is being done on tank work. We have a number of tanks with water bottom that gave trouble cracking in corners where angle iron and rivets were used. Corners are cut out and patches welded in, reinforcing same as on boiler work, and we have no further trouble with leaks.

Patches, half side sheets, half door sheets, and in fact all boiler plate work, in preparing for welding, are beveled to 45 degrees, the two inner edges coming together, and sheets securely fastened with temporary bolts. A ripper $\frac{3}{16}$" thick is run through, making a $\frac{3}{16}$" opening on inner side. The operator, in welding, welds from 3 to 4 inches flush with sheet, and goes back and reinforces weld to about 60 per cent of thickness of plate.

Cracks in side sheets that extend from one staybolt to another, are V'd out the same as preparing patch, staybolts removed and holes welded up. Cracks reinforced same as patches. Cracks in fire door are handled in same manner. Fire cracks and leaky

seams are chipped, caulked and thoroughly cleaned. Caulking edge then welded, filling up all cracks. Unless rivets are loose to begin with, it is not necessary to remove, as they do not loosen up from welding.

We had a number of cast steel car body bolsters that were cracked and laid aside. They were brought to shop and welded at a cost of between $3 and $4 each for labor and material. New bolsters cost $12.50 each.

While the electric welding of cast iron as a general proposition has not proven satisfactory, especially on parts that are under strain or steam and air tight, we are successfully welding up cracks in smoke box doors and fronts.

Electric welding has proven very valuable and profitable to us in filling up worn links, link blocks, blade jaws, saddle pockets and cellar bolt holes in driving boxes; welding new notches in quadrants, worn places in frames caused by spring rigging wearing; building up piston fits to crossheads, rod ends and straps; in fact everything that is worn or broken that it is possible to reclaim at a profit. There is no limit to its usefulness, as we always find something new to be done. To enumerate all the different classes of work we are doing, the cost and saving effect, would take up too much time on this subject.

Oxy-acetylene process of welding and cutting has passed the experimental stage, and has made a more rapid growth in the past few years in railroad work than all the preceding years combined.

Since quite a number of railroads are now being equipped with piped gases, it may be well to go into detail and show its many advantages. The Central of Georgia shop at Macon is now being equipped with a strictly up-to-date plant, which is being installed by the Oxweld Railroad Service Co. The above company, as the name implies, handles railroad work exclusively, and they have done a great deal towards the development of oxy-acetylene welding in railroad shops.

The generator house, which is located a short distance from the main shop, consists of three rooms. In the first room we have a 400-pound total capacity generator. In the next room we have a twenty cylinder manifold, and the next room is used for supplies. The generator is duplex, having two generators—one on each side of gas bell. In this way there is never any delay in charging generator, for as soon as one generator is exhausted it is cut out and the other generator cut in. The manifold works on the same principle, having ten 250 cubic feet cylinders cut into line at a time.

The two gases are piped through erecting, boiler and tank shops, stations being located at most convenient places to reach the work. Through the erecting shop we have stations between every other pit, making it possible to reach any part of engine with short length of hose. The stations through boiler and tank shops have same spacing, making the system, as a whole, a very complete arrangement.

We are installing the low pressure system, which means acetylene pressure less than one pound per square inch. The constant pressure gotten in the low pressure system is assurance of a neutral cone on the blow pipes. The oxygen line carries 40 lbs. pressure in the pipes, with proper adjustments at blow pipe. The acetylene valve on blow pipe is opened wide, leaving only the oxygen valve to be adjusted.

The welders are furnished with a small tool box in which they carry torches, hose and welding heads, so there is no time lost on beginning their work in the morning.

It might be well to mention before going further, that about three years ago we had installed at our shops an acetylene outfit, making our own gases, having only the acetylene pipes through the shops, and using drums for oxygen. We were using acetylene altogether for welding until our electric plant was installed, which considerably reduced the welding with gas, but used it to good advantage on cutting. Several months ago, while one of the welders was charging the generator, from some unknown cause there was a noise and a puff of smoke that carried off the acetylene generator. Shortly after the accident we began using gases furnished in drums.

Oxy-acetylene welding and cutting is indispensable in a railroad shop. In cutting it has the field to itself, and there is no getting around it. The cutting, alone, is a paying proposition, saying nothing of its many advantages in welding over other methods.

Our oxy-acetylene cutting and welding dates back to June, 1911, when our first important boiler work was done. Engine 1568 had half side sheets and half door sheet welded, and this job is still good and has given no trouble up to date. Before we got the oxy-acetylene gas our standard practice in removing fireboxes was to drill the staybolts on outer side of boiler, then use a pneumatic ram to break the staybolts. This would take, on large fireboxes, 36 hours, including staybolts and radial stays. Our practice now is to cut the fireboxes up into sections with the oxy-acetylene gas, then punch sheets out. The average time in cutting out a firebox in this manner is five hours, thereby saving the breaking of the staybolts and radials.

The cutting torch is used very extensively in boiler department. All patches, all side sheets, all fireboxes, and all holes in cab, cab and running boards, are cut with the oxy-acetylene torch.

As we do but very little Thermit welding at Macon shops, there is nothing I can say of interest on this subject. We have, however, welded quite a few frames, with Thermit, but the past few years we have been using oil as we have found it to be just as good and very much cheaper. We have not entirely abandoned the Thermit process at Macon shops. Occasionally we have a broken frame where we cannot get at it to weld with oil, and unless the frame has to be removed we weld with Thermit. The welds we have made with Thermit have proved very satisfactory. Have quite a number of frames welded that have been in service several years. Some few welds failed in service, the percentage of failures being very low.

Oil welding locomotive frames has been the practice at Macon shops for the past two years. Quite a number of welds have been made during this time which have proven very successful.

The success of oil welding, like all other methods of frame welding, depends largely on allowances made for expansion and contraction. It is a very easy matter to make welds as shown in cuts and one two on pedestal legs where expansion is very easily taken care of. The most difficult job we have found is shown in cut 3 where top and bottom rails are broken. We have made two welds of this nature, one of which failed and the other still in service.

There is but little expense attached to this method of welding. The outfit consists of small oil burner, oil tank and two small battering rams. The entire outfit is mounted on four wheel truck which is easily handled around the shop. Material used—crude oil, fire brick and fire clay, which amounts to about $2.00; balance of expense being labor, which amounts to about $6.00; making a total cost for preparing and welding frames an average of $8.00.

In preparing frame for welding we cut out straight through frame where broken with acetylene torch, trimming off afterwards with hammer and chisel to get rid of scale and burnt metal made with torch. Frame is then jacked apart and good hammered iron inserted, leaving projection of ½″ all around. Furnace is built around frame with fire brick, leaving opening for burner which is placed within a few inches of opening. When frame is brought close to welding heat, the oil is cut down, allowing heat to soak thoroughly through frame. Oil is then gradually increased until frame reaches welding heat, and jacks are removed letting pressure come on before furnace is knocked down. Furnace is then knocked down, and hammers and battering rams used for hammering up dutchman, leaving the frame slightly reinforced, while the heat is on all surplus metal is chipped off.

In the case of a fork and binder lug broken off we cut off

pedestal leg about 4″ from top rail of frame, get out new leg, machine all over, drill and cut keyways, leaving ½″ long. It is bolted in position and left hanging down ½″. Binder is put up and jack placed under frame, heat is taken and frame jacked up to within $\frac{1}{32}$ of place and welded. When cool, it comes to proper length.

With oil welding there is no heavy reinforcing to come in way of spring rigging braces, shoes and wedges, etc., causing some alterations to be made in some standard fitting.

On the Atlantic Coast Line Railroad, the following practices prevail.

For all heavy work, such as locomotive frames, we use "Thermit." For light work, such as boiler and tank sheets, steel car parts, small broken castings, iron, steel, brass, aluminum, etc., we use the oxy-acetylene process.

We find in making autogenous welds one of the principal points to consider is the shrinkage. To make a perfect weld, aside from the actual welding operation, the parts when cold should be free from strains. With Thermit we have made perfect welds on locomotive frames in almost all localities. In making these welds the only parts necessary to remove from the engine are those which will come in the way of setting the mold and locating the crucible.

Our average cost for making Thermit welds is from $15 to $20, not including the removal or application of parts necessary to make the weld.

The oxy-acetylene process is one of the handiest and the largest time and labor savers we have in our shop.

We use the cutting torch for a variety of operations, for instance, cut away stock for Thermit welds, do all sheet cutting, cut bolts which do not easily come in removing steam pipes, when making new equalizers which have slots, the stock, after drilling is cut out by this torch, crown sheets which have come down by accident have the distorted sections cut out and tank sides which have been damaged have the bent or broken parts cut out, and for application of new pieces and numerous other operations. With the welding torch we have repaired broken cylinders, all kinds of boiler work, broken steam and exhaust pipes, air pump heads, gear wheels, pulleys, built up the inside lap of slide valves, malleable iron parts for cars, parts for air drill, cast steel parts of various shapes, brass parts such as lubricators, brass and aluminum castings, and in fact, there are very few parts which are usually found about a railroad shop which cannot be repaired.

We have experienced some trouble in welding broken flue sheet bridges, welding spokes in pulleys and other like operations in taking care of the shrinkage. We have overcome this in a large measure by preheating.

I consider that autogenous welding has very materially reduced our cost of repairs and in addition our engines are not kept out of service near so long as they would be had we to take parts down and repair in the old way.

In our boiler shop, alone, I consider that the oxy-acetylene process has reduced our labor cost 20 or 25 per cent.

The Chicago & North Western is using three methods of welding with very good results in each case: viz: oil welding, Thermit, and oxy-acetylene welding. If we have any light frames broken, say through the pedestal jaw or lower rail, or back braces, we resort to oil welding as we consider it much cheaper and quicker than any other process and have had none of these welds come back on us. For broken frames on our heavy power we use Thermit almost entirely, and with very great success. It is true we have had one or two cases where the frames have broken again at the weld, but I do not believe that the Thermit was to blame so much as the men doing the job, in not allowing enough for contraction in the cooling process, and thereby putting an undue strain upon that part of the frame.

We have but recently gone into the oxy-acetylene process of welding, but we have done good work so far; such as cutting out patches in fireboxes, repairing cracked cylinders, cracked valve chamber bushings, repairing broken brake hanger castings to save the expense of removing them from the frame, also of throwing them into the scrap bin. We are filling in the worn parts of brake hanger pins, thus saving taking them out and applying new pins, welding brake hanger brackets without removing them from the frame, welding front end doors and frames when cracked, cutting off the risers and gates after Thermit welding, and several other operations of a similar nature.

The other day we experimented a little on cutting out a firebox from one of our S.2 type of power, and it took us but four and a half hours to cut across the top of the two side sheets, the flue sheet and the back sheet of the firebox, so that when the staybolts were broken down and the mud ring rivets driven the box was ready to drop. This time includes that of getting everything ready and removing the tanks, etc., after the cutting was done. We are next going to see which is the quicker way of removing the crown bar stay rivets, by driving the old way or that of cutting off the heads first with oxy-acetylene and then driving out the rivet.

In the welding of locomotive frames at Dubuque, Ia., shops with crude oil, we have been very successful since we commenced about five years ago, having made over 200 welds on all parts of the frames during that time. When a frame is broken on the C-1, A-2 or B-4 class or L-2 class, which is one of the largest class of engines the company has, when one of these frames break they are never taken down to repair. If broken through the back or the brace or the leg, the break is drawn together with clamps and the exact length is taken, then a 2″ hole is drilled down through the center of the break, then an air power hack saw saws out the broken parts, leaving a straight surface, then the frame is expanded about ⅞ of an inch with screw jacks, then a tin template is made to fit the opening and a block is machined to the template, making a nice fit. The block is driven to place, making a nice job ready for welding. A furnace is then built allowing 2½″ from each side of the block and 3½″ on the top and bottom and extending out about 13″ from the frame. The burner is then started and in about two hours on a section 5″x6½″, the frame will be ready to weld, which is done by dropping out the jack, allowing the enormous pressure to come forward and make a perfect butt weld. The burner is quickly removed and small battering rams are used to weld up the sides. If the frame should not come to the desired length a heavy battering ram is used and with a few blows the frame is brought to the proper length. On the class C-1, A-2 and B-4 where we have put on several new re-inforced ends on the main frames, we have never had a weld give way yet, although the new re-inforced ends have broken which speaks well for our method of welding with crude oil.

One of the particular points in the frame welding is to be sure to get the grain of iron placed the proper way in the frame. Also the average cost in welding these frames is about $7.50 for blacksmith work and $8.00 for machinist's work, making a total of $15.50.

Experience now indicates that the two methods, electric and oxy-acetylene welding, have advantages over each other in certain different operations. For welding flues to back flue sheet, filling in on caulking edges, reinforcing small corroded parts, or where it is important to confine the high temperature to as small an area as possible, due to contraction, the electric process is superior.

For large boiler patch work, new half or whole side sheets, long cracks, or in work where suitable provision for contraction can be readily provided, and in cutting or removing defective parts on old sheets, the oxy-acetylene excels. It is therefore clear that in large shops the installation and use of both methods is not only desirable, but an excellent paying proposition.

Both systems can be so installed as to make their use convenient to each engine pit and other desirable locations, and in such manner that a number of operators can work at the same time.

The use of the apparatus and particularly the torch, requires like everything else, some intelligence and experience to obtain the best results. The most important feature the operator must learn is to so manipulate his work to avoid, as far as possible, excessive contraction of cooling parts. It is quite possible to make what at first appears successful welding, but due to excessive internal strains, either the weld or the adjacent sheets will eventually crack, materially shortening the life of the repair.

In the welding on of new side sheets, the welding should be, as far as possible, done before any permanent fastening or riveting. Welding of long vertical cracks or seams of firebox sheets can be nicely provided for by a small running stream of cold water each side of crack while the welding is in operation and the heating of sheets thereby confined to a very small space. Horizontal seams and cracks in fire boxes are best made before mud ring rivets are driven. In the application of firebox patches, suitable provision for the contraction of cooling parts can be frequently provided by slightly dishing or cupping the new patch to be applied, which is afterwards pulled in straight by nut and bolt before staybolts are applied.

In repairs to fire door cracks, experience strongly indicates, for back shop practice at least, better results are obtained by cutting out the cracks, replacing by patches, sizes of which are governed by nature and size of crack. Merely welding up old fire door cracks usually leads to future trouble, since the crack starts from the inside and can be only partially seen from the outside with result that all of the crack is not completely welded up, and possibly cracks existing on water side and not visible from outside may be increased by the strain of contraction from heat of welding a close adjoining crack. By cutting out cracks visible from outside and welding in patches of new material this trouble is all eliminated.

The welding in by oxy-acetylene of new full, or half side sheets, or strips from 12″ to 24″ high all round bottom of throat sheet, outside sheets or wrapper sheets and back head is a most decided success from many standpoints, including a first-class permanent tight job, great economy of both labor and material as well as the saving of time over the old methods. With the old method, in case side sheets were in bad condition only at the bottom near grates, still it was necessary to renew sufficiently high to bring seams and rivets out of fire line. With the welding process only the defective portion need be renewed and if necessary, seams made through fire line.

Experience has already shown the peculiar advantages different methods of welding have over one another in different operations of shop work. The future will doubtless draw still more distinct lines around their individual fields of usefulness and economy. It is now a frequent practice to burn out the necessary gap by means of oxy-acetylene when welding frames with Thermit or even electric frame welding.

The Thermit process of welding as applied to the railroad repair shop, particularly in its field of frame welding, maintains its advantage in the element of time, portableness in manipulation, simplicity of apparatus required and its convenience to the smaller outlying points of modern facilities. In the back shop after the engine is stripped, ordinary frame fractures are Thermit welded in four and one-half to six hours from start to pour. Mould boxes to conform, to meet all required shapes, are built up from adjustable iron plates specially designed for the purpose, and which form part of the welding equipment. The sand can be used over again if handled with some discretion and a small amount of fresh fire clay. The crucible lining should average twenty pours, and then is a simple matter to reline. A special small four-wheel truck will provide for all necessary appliances and tools, which can be carried or shipped and used wherever the locomotive can receive what necessary stripping required.

The Thermit process is one of the oldest of autogenous welding in the railroad shop, although there has, even here, been recent improvements and changes affecting details, which have brought about further improvements and economy. Special railroad Thermit is now obtained already mixed with the proper proportions of one per cent nickel, one per cent pure metallic manganese, and fifteen per cent low carbon boiler punchings, thus relieving the shop entirely from what previously was one of the most important features for best results.

Unless a very high quality of crude oil is available, kerosene is much more desirable for preheating, since crude oil, particularly of the heavier gravities, leaves a sooty deposit or film of carbon on the heated parts which prevents the hot Thermit metal from coming in direct contact with the stock. Also the carbon when burned off by the hot metals forms a gas and causes blows or honeycomb welds. In making Thermit welds it sometimes happens that upon machining, it is found that the metal is not perfectly solid, and it is often assumed that this fact is peculiar to the Thermit process and cannot be avoided. This, however, is not the case. As welding with Thermit is essentially the same as making a steel casting, the same process of reasoning will apply to both cases, in so far as the conditions are the same. In making steel castings, the chief cause of blow holes is the presence of ferrous oxide in the metal and this is usually removed by the addition of some very active deoxidizer, such as aluminum, manganese or silicon. Thermit itself is a mixture of iron oxide and aluminum mixed in such proportions as to completely reduce the oxide. The manganese is added to the charge of Thermit to reduce all oxides which may be present in or on the parts to be welded, and therefore it is evident that the blow holes which sometimes occur in Thermit welds cannot arise from this cause. It is the writer's opinion, based from many observations of frame welding, the explanation is to be found in the difference of temperature between the parts to be welded and the Thermit steel when poured.

When a weld is made with Thermit in the usual manner and the parts to be welded are not brought to a high temperature before pouring, a small volume of Thermit steel is brought into contact with a larger amount of comparatively cold metal, which conducts away the heat of the former so rapidly at the junction of the two metals that it soon becomes too thick to flow and as the mass cools, the decrease in volume, due to shrinkage, is not provided for by the metal in the riser, resulting in shrinkage or blow holes.

Therefore, in order to obtain perfectly sound welds with the Thermit process it is absolutely essential when the pour is made that the parts to be welded be at least a bright red heat. The preheating should be done inside the mould, and in this way not only the parts to be welded are thoroughly heated, but also the interior of the mould as well.

Committee: C. L. Dickert, (Chairman), R. B. Van Wormer, C. M. Newman, A. A. Masters, F. P. Miller, Wm. Hall.

DISCUSSION.

Oxy-acetylene, electric and Thermit welding processes were taken up separately and each process was given a thorough discussion. Out of seventy-seven engine frames welded on one road there had been but two failures, and the cost was $77 for the oxy-acetylene weld as compared with $217 by the old process. A. F. Beyer (St. L. & S. F.) stated that they are welding all their side sheets, not bolting them up until after the welding is done. Circular patches are corrugated and two staybolts taken out on each side of the patch. Mr. Beyer reported having welded the superheater flues on a Mallat in May, 1913, and the engine is still in service. He has had some trouble in welding cast iron, however. Vertical cracks are being welded successfully at the Silvis shops of the Rock Island, and all superheater flues are being welded in. The Collinwood shops of the Lake

Shore were reported piped throughout for oxy-acetylene welding. The Memphis shops of the Illinois Central have done some very successful welding of cast iron cylinders, said W. F. Laurer. Their method is to preheat the cylinder with charcoal to a cherry red, make a V in the crack and use cast iron in the welding. The minute the weld is made the cylinder is covered with asbestos and allowed to cool off for 24 to 36 hours. The welds are usually made on the outside of the cylinder.

In the discussion of the electric welding process, C. L. Dickert (Cent. of Ga.) favored electric welding of flues, stating that when welding electrically with one operator the current cost about 10 cents per hour and 22 cents with two operators. Several reported good success in welding flat spots on wheels with the electric process. I. C. Newmarch (L. S. & M. S.) said that the big chips from the wheel lathes came in very handy for flat spot welding.

G. H. Logan (C. & N. W.) had had but five failures in 134 Thermist welds, three of which were "man failures." Over a hundred Thermist welds had been made at the Silvis shops of the Rock Island with no failures. H. O. Warner (L. S. & M. S.) reported a case in which he ran short and made the weld in two heats. This was done to meet an extraordinary situation but a representative of the Goldschmidt Thermit Co. stated that due to the expansion and contraction it was always preferable to make it in one heat. Several others gave instances of the successful use of Thermit.

C. B. Baker, president of the American Railway Coppersmiths' and Tinsmiths' Association spoke to the convention on Friday on behalf of his association. He said that they planned to meet at Chicago at the time of the General Foremen's convention in 1915 and at the same hotel, if agreeable. The matter was referred to the executive committee.

ASSOCIATION BUSINESS

W. W. Scott was re-elected president for the coming year and the following new officers were elected: First vice-president, L. A. North, Ill. Cent. R. R., Chicago; second vice-president, Walter Smith, C. & N. W. Ry., Chicago; third vice-president, W T. Gale, C. & N. W. Ry., Chicago; fourth vice-president, W. G. Reyer, N. C. & St. L. Ry., Nashville, Tenn.; secretary-treasurer, William Hall, 914 W. Broadway, Winona, Minn. C. L. Dickert, Cent. of G. Ry., Macon, Ga., was elected chairman of the executive committee.

About 120 members were registered in attendance.

The topics for the 1915 convention are as follows:

Valves and Valve Grinding.—W. I. Smith, C. & N. W. Ry., Chicago, chairman.

Rods, Tires, Wheels, Axles and Crank Pins.—A. A. Masters, D. & H., Watervliet, N. Y., chairman.

Shop Efficiency.—Geo. H. Logan, C. & N. W. Ry., Clinton, Ia., chairman.

Oxy-acetylene Welding.—F. A. Byers, St. L. & S. F. R. R., Springfield, Mo., chairman.

Roundhouse Efficiency.—N. B. Whitsel, C. & N. W. Ry., Chicago, chairman.

TRACTOR TRUCKS, BUTTE, ANACONDA & PACIFIC RY.

The Butte, Anaconda & Pacific has recently ordered from the General Electric Company four additional freight locomotives which will be duplicates of the seventeen 80-ton units put in service about a year ago. In order to make these locomotives suitable for very slow speed spotting service, there have also been ordered three additional tractor trucks which can be used in combination with the standard locomotive units. These trucks are an ingenious adaptation of standard parts of the freight locomotives, increasing the tractive effort of the standard unit to the equivalent of a 120-ton locomotive. These units will be used especially for spotting cars at the smelter and also for low speed switching in the Butte yards.

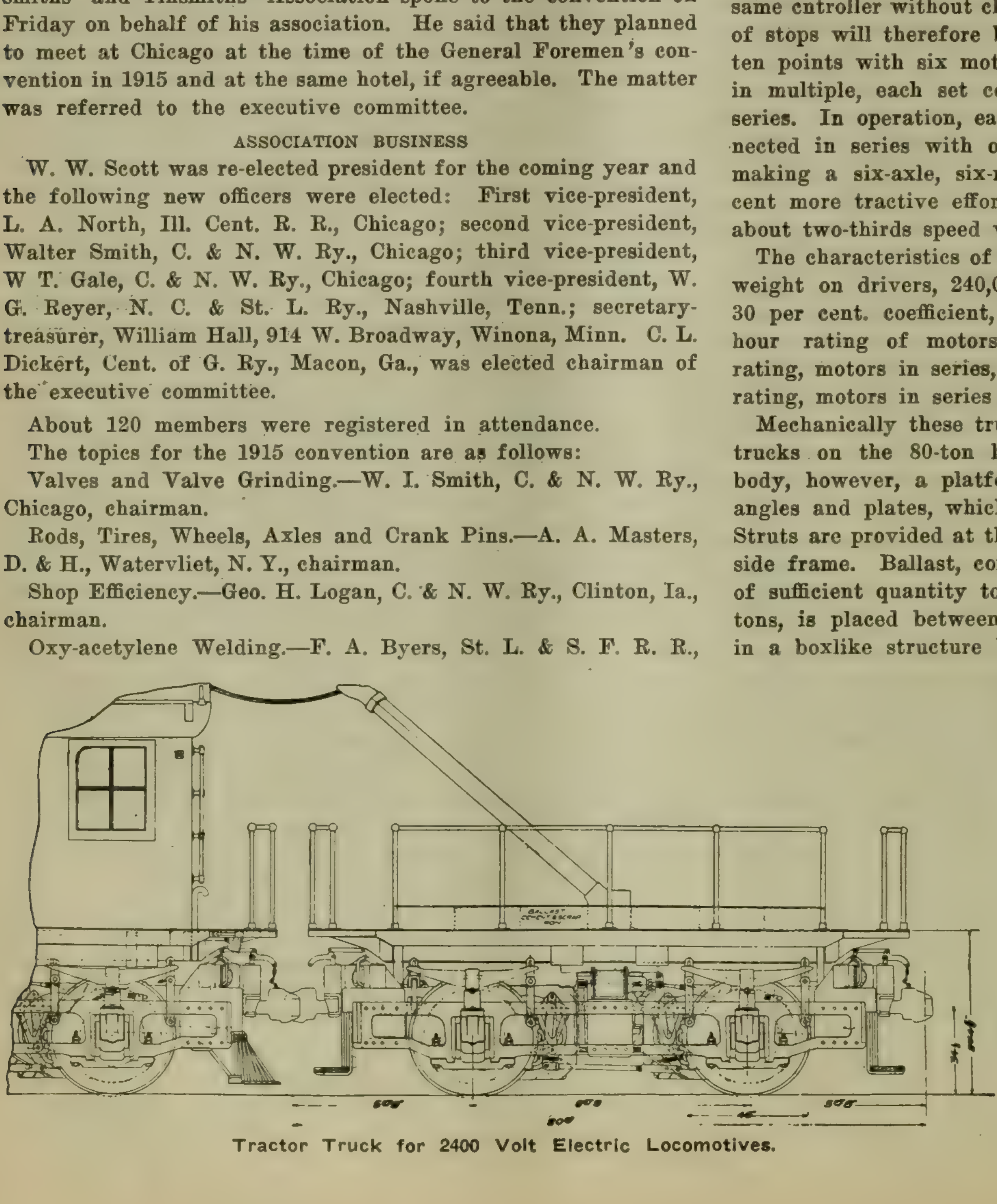
During the present year it is expected that approximately 25 per cent more ore will be transported from Butte to Anaconda than was hauled last year. This increase arises from the transfer of ore which was previously hauled to smelters at Great Falls. The additional haulage will bring the total annual traffic on the road up to about six and one quarter million tons.

The three two-axle tractor trucks will each be equipped with two GE-229 motors insulated for 2,400 volts similar to those on the locomotive. Cable and connecting plugs will also be provided for operation with the locomotives, so that the truck motors will be operated with the other motors from the same cntroller without change in the main control. The number of stops will therefore be the same as on the the locomotive; ten points with six motors in series and seven with two sets in multiple, each set consisting of three motors arranged in series. In operation, each of the tractor truck motors is connected in series with one pair of motors on the locomotive, making a six-axle, six-motor unit which will furnish 50 per cent more tractive effort than the 80-ton locomotive alone at about two-thirds speed without increase in current input.

The characteristics of the 120-ton unit are as follows: Total weight on drivers, 240,000 pounds; starting tractive effort at 30 per cent. coefficient, 72,000 pounds; tractive effort at one hour rating of motors, 43,200 pounds; speed at one hour rating, motors in series, 4.8 miles per hour; speed at one hour rating, motors in series parallel, 10.3 miles per hour.

Mechanically these trucks are similar in construction to the trucks on the 80-ton locomotives. Instead of a locomotive body, however, a platform is supplied, built up of channels, angles and plates, which are supported on the truck transom. Struts are provided at the corners to secure the platform to the side frame. Ballast, consisting of cement and iron punchings of sufficient quantity to bring up the weight of the truck 40 tons, is placed between the center channels of the platform in a boxlike structure built for this purpose. A passageway protected by a hand rail extends along each side of the platform.

In the center of the platform there is a crane which extends at an angle from the platform floor, suitable for supporting the eight cables necessary for connecting the motors of the tractor to those on the locomotive. This crane can be revolved 180 degrees so as to permit the coupling of the locomotive to either end of the truck. When in operation this crane is rigidly locked in position. Air brake equipment with the necessary triple valve, auxiliary reservoir, etc., is also installed on the truck.



Tractor Truck for 2400 Volt Electric Locomotives.

Tool Foremen's Convention

The sixth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, on July 20, 21 and 22, 1914. The meetings were presided over by the president, A. M. Roberts of the Pittsburgh & Lake Erie. J. F. DeVoy, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, favored the association with an address at the opening session.

Standardization of Reamers.

By C. A. Shaffer, Ill. Cent. R. R., Chicago.

The writer believes that in the majority of cases standardization of reamers for all the various classes of general work will show good results if properly carried out. However, if conditions would permit of going into the matter only in a general way, possibly on account of not wishing to replace all of the large stock of tools of various descriptions at one time, we may select one or more sets from the following list of reamers to start with, any one of which when completed and put into practical use should show a good saving as compared with old methods.

Cross-head and piston reamers.

Knuckle pin reamers.

Ball joint reamers.

Rod and frame bolt reamers.

By the use of such standard well designed and constructed reamers of those first mentioned, it will be seen that a saving in time of from one to eight or ten hours may be effected on jobs as compared with the old practice of putting the work into a machine and boring to a fit. Then, too, the life of the job will be much greater if done with the proper tools.

A conservative check on the average time being consumed on several operations in a certain shop on a large road was as follows:

Bolting cross-head to face plate on a lathe and re-boring for pin or rod fit, three hours and fifteen minutes to three hours and forty minutes, as against twenty minutes by using a standard reamer.

Clamping rod on horizontal boring mill or drill press, and truing up knuckle pin hole with a boring bar and cutters, two hours, against fifteen minutes with a reamer.

Clamping steam or dry pipe to horizontal boring mill and truing up joints with bar cutters, two hours and forty-five minutes, against thirty minutes with standard ball-joint reamer which would make a seat with standard radius.

These are only the initial time savings and much more will be realized when it comes to assembling, if the parts are standard and can be put together with great ease and speed, instead of the usual amount of filing, scraping and grinding to produce a good fit or a tight joint.

The design and construction of standard reamers, which is not covered by this topic, is a very important factor in the successful use of such tools, but this has been discussed at previous meetings in a general way, as regards spacing and angles of teeth, clearance, material used, etc., and it is no doubt well that it be left to the judgment of the tool foremen who can work it out to best suit conditions.

Before making up drawings for such standard tools, one should carefully study their requirements for limitation of dimensions for the various types of locomotives, anticipating, if possible, new power which the road may require. The importance and economy of this may be seen if you will take, for instance, commercially manufactured locomotive taper reamers, such as are catalogued by all the leading small tool manufacturers for use on rod and frame work. The standard length of these reamers, in proportion to size, when designed would, no doubt, meet the requirements of proportionately sized parts of small locomotives then in general use, but the same tools which are still being shown in catalogues, come far from being of suitable length for use on the heavy power of today. Many shops have a large stock of these reamers on hand, a number of sizes of which are practically worthless, as they are not long enough to reach through the work. A revision in standards along this line would no doubt result in increased conditions for the manufacturer and economy for the roads who buy the greater portion of such tools instead of making them themselves.

One of the main advantages in the use of standard reamers is that it permits of interchangeability and carrying in stock finished or rough turned parts for immediate application.

By E. J. McKerman, A. T. & S. F. Ry., Topeka, Kan.

On the Santa Fe lines all of our frame reamers for locomotives have 1/8" taper in 12", and are carried in sizes from 1/4" in diameter, advancing by 32ds to 2" in diameter. These reamers conform as nearly as possible to the manufacturer's or commercial standard. That is, we buy from the manufacturer, all sizes of reamers 1" and under, and make all sizes over 1" in our Topeka tool room. These reamers are carried in lengths from 5⅝" long, up to and including 17½" long. We also have them 1⅛" to 2" in diameter, and 28½" long. These are called extra long reamers for use on frame work and also run in 32ds.

As to the cross-head and piston reamers, we have adopted nine reamers for this class of work. These reamers are tapered ½" in 12", and are spiral. They run in sizes from 2" at the small end of the smallest, up to 5" at the small end of the largest, and have 15" of flute, with a Morse taper shank to fit the large boring mills. When it is necessary to use these reamers in the lathe, they are squared off on the shank, so that we can apply an open end wrench to screw them.

For our knuckle pin work on side rods we have four reamers. These reamers run in sizes from 1 21/32" at the smallest end of the smallest reamer, to 3⅞" at the small end of the largest reamer. They have 9" of flute and 1½" taper in 12", with a left hand spiral, 68.57 pitch. These reamers have from a No. 4 to a No. 5 Morse taper socket, and also are squared on the shank so they can be handled with a wrench when necessary.

For our link blade pins, we have one standard taper reamer, straight flute, 12" of flute, taper ¾" in 12", 1¼" at the small end, with a No. 4 Morse taper shank. This one reamer takes care of all of the jaws on our Stevenson link motion.

Our standard reamers that are used in all holes on cylinder splices; that is, where the cylinders are joined together, are also used on flanges for truing up the holes after the cylinders have been bolted up complete. These we term saddle flange reamers. They are 6" over all, with a square shank, and are carried in sizes from 1" to 1 55/64, by 64ths. They are fed into the holes with a ½" screw. It is necessary to have this style of reamer on our line on account of having so many compound engines, and we find they work very satisfactorily. These reamers are 1/8" taper in 12". We also have special guide reamers which take care of all of the guide work. All of these reamers, as above stated, have the same taper.

On our general motion work we have two reamers. These reamers are 17½" and 19½" in length over all, and have a taper of ½" in 10" on the Walschaert valve gear, and on the Stevenson they have a taper of ⅜" in 12". They are 1¼" on the point, and have a left-hand spiral.

All of the above reamers are made from Crescent special tool steel, Grade "E," and I am pleased to say that we have little or no trouble whatsoever from breakages, due to improper tempering or grades of steel.

As to Rose reamers, will say that we use the shell reamers, which are secured from the Cleveland Twist Drill Co., and are known as their Peerless high speed reamers, No. 521. These reamers have high speed steel inserts, or in other words, the faces have high speed steel inserts, brazed in. These reamers give entire satisfaction. They have a taper shank, and we use

them in lengths from 14" to 16" over all. We make our own arbors, and apply the shells as received from the manufacturer. These are standard over the entire system.

By J. T. Meager, P. & R. Ry., Reading, Pa.

Reamers for valve rods, cross-heads and piston rods all have ⅝" taper per foot. We make these reamers with a straight heavy pitch flute with a variation of the pitch from .000" to .016" from cutting edge to cutting edge; that is, in milling the flutes we gain .016" on the first half of the diameter then drop off until we are back to zero. I find very little difference in the life of the straight and spiral flute reamers.

By J. E. Dosser, Sn. Ry. Knoxville, Tenn.

For frame reamers we use $\frac{1}{16}$" taper in 12". We carry in stock reamers from 6" to 18" in length. The 18" lengths are special and are long enough to cover all frame splices used on the power of the Southern Railway.

DISCUSSION.

A. R. Davis (Cent. of Ga.) stated that on his road the lengths of reamers had been changed and that they are now 6" in length or multiples of that number. A number of members were of the opinion that the reamers furnished by the manufacturers were invariably too short for the work necessary on the present large engines. C. A. Shaffer (Ill. Cent.) moved that blanks be sent to all members so that they might fill in their requirements as to length and taper, with a view of fixing on a standard. This motion was carried.

Tool Room Grinding.

By W. C. Diebert, C. & O. Ry., Clifton Forge, Va.

We have a surface grinder of our own make and have just completed an automatic reamer grinder that will prove a blessing to us. After setting the machine it will grind the reamer without any attention whatever. We also have a small die grinder for grinding cutters, which is home made. This will grind cutters up to 14" in diameter and grind the radius on cutters for channeling driving rods, grinds the side, rounds the corners and grinds the face at one operation. I find that wheel lathe tools stand up best with a 7 degree clearance angle and we use a 10"x1½" hard wheel for grinding these tools.

We make all our special taps and reamers. Taps that must be backed out we give about 2 degrees clearance and taps that are run through the work we give a little more. Bolt threading dies are ground at an angle of 25 degrees.

Chasers having a lead of from 4 to 5½ are given a 15-degree angle, and from 6 to 8 pitch an angle of 20 degrees. A wheel ⅛ larger than the size of chasers is used to grind the clearance.

By J. C. Bevelle, El. & S. W., El Paso, Texas.

To get what should be the life of a drill is to see that it is properly ground at the pint. The two cutting edges must be exactly the same length and should be at an angle of 50 degrees for ordinary purposes. For general work we insist on a 12-degree angle of lip clearance. This angle, however, should gradually increase as the center of the drill is approached until the line across the center of the web stands at an angle of 135 degrees with the cutting edges.

For a heavy feed in self material, the angle of lip clearance may be increased to 15 degrees, but care should be taken that the angle at the center is given a corresponding increase. The failure to give sufficient angle of lip clearance at the center of the drill is the principal cause of splitting drills up the web. The breaking of tangs, etc., is all due to the fact that the drill is not properly ground. Our method of the up-keep of reamers is not to allow them to be put in the rack until they have been inspected, and if needed, put in first-class condition before they can be put in the rack.

We grind all taps on the face of the flute just enough to renew the edge of the teeth. The points of the tap are ground with a relief of about 3 degrees. In repairing a tap that has one or more teeth broken out, they should be removed so as not to cause damage to the others. In grinding milling cutters the teeth are sharpened on a cutter grinder using the finger of the machine as a means for obtaining the proper current. The teeth may be given an angle of about 3 degrees; that is, the angle between the face of the teeth and the top of the teeth is about 87 degrees. If this degree of clearance is given, the cutter will cut free and last well.

We grind peg milling cutters in the following manner. A groove $\frac{3}{16}$" wide and $\frac{1}{16}$" deep is milled between each row of cutters. The pegs are inserted on a spiral and the groove is milled to exactly the same lead. With the guide or finger inserted in this groove a steady, even travel is given the cutter, which allows the operator to save much time. It also permits him to use a heavy guide, disposes of all spring and assures the operator that the cutter will be perfectly true when finished.

Heavy roughing tools used on wheel lathes for turning tires are ground to the following angles: clearance angle, 6 degrees; back slope, 8 degrees; side slope, 14 degrees. The finishing tools for tire turning have a clearance of 6 degrees with a back slope of 8 degrees.

By Owen D. Kinsey, Ill. Cent. R. R., Chicago.

Our observations of grinding wheel performances have gradually been bringing us to coarser grains and softer bonds. We have found that a cool free cutting wheel is the most economical in the long run, even though the wheel life is shorter.

Clearance angles should be from 5 to 7 degrees for reamers and milling cutters. The clearance should not exceed 5 degrees for reamers, as more clearance only causes the cutting edge to wear quickly with no apparent advantage. In order to obtain accurate clearance angles we bring the work centers central with the wheel spindles by the use of a center gauge. Then referring to a chart mounted on each machine the operator can see at a glance just how much movement of the table is necessary to produce the desired clearance.

By Thomas F. Eaton, B. & O. R. R., Baltimore, Md.

We have 70 wheels in service and find that it pays to have one man do the work of inspecting wheels all over the plant. In this way we are enabled to keep the wheels in a safe and efficient running condition.

For the rough grinding of machine tools we use a wheel with No. 24 grain and a medium soft bond, and for the universal tool grinders on finished tools we use a No. 60 grain, grade M.

I have reclaimed a large number of high speed frame reamers and drills by welding the shanks that are broken off by means of the oxy-acetylene process. We cut the shanks off square, then give them a flat point of about 45 degrees. We then saw off another piece of carbon steel to make up for the part of the shank cut off. This is also given a flat point and we then run on some welding material to each one of the flats separately, and put them in line until they are cold. I then weld them together, put them in line again and when cold they are tried for straightness and ground up on the universal grinder. These shanks have given good service.

Crown bolt reamers are made with nine teeth, 70 degrees angle of flute, ¾" taper per foot, and have a 4 degrees clearance. Bridge reamers have five to seven flutes, 75 and 80 degrees angle of flute and are ground with 6 degrees clearance. The reamers in use on piston heads are made with inserted blades, three of the blades being spiral and the rest straight. These reamers are ground with from 6 to 7 degrees clearance.

DISCUSSION.

Considerable trouble was reported due to the checking and cracking of reamers and a number were of the opinion that this was due to uneven heating in tempering. The trouble had been done away with in a number of instances by substituting dry grinding for wet grinding, and the majority of opinions expressed were in favor of dry grinding. As one member said, it had rather of a psychological effect on the operative as the sparks gave him an indication of the way he was using the tool.

Experiences of welding shanks on broken reamers were reported by a few members, with varied results. Henry Welter

(L. S. & M. S.) found that the tools stood up well after welding. He added soft machine steel in welding and did not protect the body of the reamer. A. M. Roberts (B. & L. E.) was able to do a better job by brazing with the oxy-acetylene process, while A. R. Davis (Cent. of Ga.) preferred the electric process because it localized the heat and did not draw the temper. A. Sterner (C. R. I. & P.) found that welding tips of high speed steel on soft steel was working very well. As an instance he cited an example of from 27 to 30 pairs of wheels being turned with one of these tools.

Machine Repairs.

By J. B. Hasty, A. T. & S. F. Ry., San Bernardino, Cal.

On our road, machines for general repairs are taken to the tool room, dismantled and all serviceable parts used. All small cast gears that require renewal are replaced with steel. Parts that cannot be machined in the tool room are handled by the machine shop foreman and returned to the tool room, where they are assembled and machines tried out before being placed in service. Light repairs are made throughout the shops by repair men from the tool room. All machines have serial numbers and a record is kept as to their location.

By Geo. Tothill, B. R. & P. Ry., Du Bois, Pa.

To handle machine repairs to the best advantage a portion of the shop should be allotted and thoroughly equipped with all necessary tools for repairing and testing the various machine and pneumatic tools. A competent man should be selected to take charge of the work and reporting directly to the general foreman. However, he must work in conjunction with the machine foreman.

Every machine tool should be given a shop number when purchased, and these records kept by the man in charge of machine repairs as well as a record of the condition of all tools, whether good or poor. When a machine has outlived its usefulness it should be passed on jointly by the repair man and machine foreman and a detailed report made as to its condition, with recommendations as to whether it should be scrapped. A full set of catalogues of all tools in service should be readily accessible to the repair man, so that he can order promptly.

By G. W. Smith, C. & O. Ry., Huntington, W. Va.

A great many of the machines now in use were built before the introduction of high speed steel, and in that day were considered substantial enough for the work that would be put upon them. As the result, a great many gear wheels of all kinds are giving away under the strain. In the majority of cases the breakage results from overstrain. In order to overcome this we strengthen wherever possible the duplicate part, and in the majority of cases broken gear wheels, worm wheels, worms and racks are made of Bessemer steel. A great many small broken parts of machines are forged and machined to shape out of Bessemer steel and prove much more durable than formerly.

In making repair parts for the machine tools we find it very economical to keep one or more extra castings ready to be out in position in case of a breakdown.

DISCUSSION

The quality of work and the selection of material were emphasized as the most important factors in machine tool repairs by one speaker. The matter of replacing broken gears was gone into and a number believed in replacing broken gears of any sort with steel gears. Soft steel for the worm and brass for the gear were reported as giving good results in worm gearing; also good cast iron with case-hardened worm. Another member made both worm and gear out of crude steel and said he had had no trouble in four years.

C. A. Shaffer (Ill. Cent.) made the point that in many shops, if a tool or part of a machine is broken down, no consideration is given to the cost of repairing. The foreman should see to it that he knows the costs. He suggested that the foreman have catalogues of all tools with which he has to do in order to facilitate repair ordering and also that he keep a record of the manufacturer's serial number on all new machines that come in, as this would assist greatly in ordering new parts. He urged the anticipation of repairs in advance of needs wherever possible.

J. W. Pike (C. R. I. & P.) reported that the machine repairs at Silvis were under the tool foreman and that four men are employed for this work, one of which does nothing but inspect the various machines and cranes. This results in eliminating many delays. A member stated that he keeps track of the cost of repairing pneumatic tools and when the cost starts going up, a new tool is ordered.

Distribution of Shop Tools.

By Henry Otto, A. T. & S. F., Topeka, Kan.

Tool checks are given to the workmen in order that they may draw additional tools the number depending on the department in which he is employed as follows: machine shop, eight checks; erecting shop, five checks; boiler shop, ten checks; all other shops five checks.

The rules of a shop require that all tools except standard kits be returned to the tool room on the last working day of each week for inspection. Anyone failing to comply with this ruling is reported to the general foreman who in turn notifies the various department foreman by letter. The department foreman calls the man's attention to the matter and if he violates this ruling for three consecutive weeks he is disciplined. In case a tool is found to be defective, is broken, damaged or lost, the department foreman fills out a tool breakage clearance card. Lathe, planer and shaper tools, hand drills and soft hammers are replaced without a clearance from the foreman, by returning damaged tools to the tool issuing room. The tool breakage clearance cards are placed on file by the tool checker, and at the close of the month are turned into the office of the tool foreman, together with an invoice of the tools on hand in the tool issuing room. The tool foreman checks over the clearance cards and then determines the number of tools required for future needs. The clearance cards are then turned over to the supervisor of tools who makes out a statement which is then sent to the superintendent of shops. This statement enables the superintendent to keep fully advised as to the tools damaged, broken or lost during the month and party responsible for same.

Showing Tool Racks in a Santa Fe Tool Room.

The store department keeps in stock a sufficient quantity of standard tools to supply the needs of the service. If any of the standard tools on hand run low, the supervisor of tools issues an order to the general storekeeper who in turn makes out a shop order to the tool manufacturing department for all tools required. The above outline is a general explanation of the Santa Fe tool checking system.

By Geo. W. Nutt.

The tool room counter over which tools are handed out should run the full length or width of tool room and should be so arranged as to permit the placing thereon of the tools most frequently called for so that they shall at all times be accessible to the tool passer. The various other tools should be placed on the revolving rack located immediately behind and parallel to the tool room counter.

Each gang foreman on the erecting sides of the shop should have a tool cupboard where tools such as wrenches, hand punches, set of die nuts, stud nuts and gang motors can be kept. These cupboards should be in charge of a tool boy.

All tools not permanently kept in these cupboards should be returned to the main tool room immediately after they have served the employes purpose. All motors should be returned to the tool room to be examined and thoroughly oiled at the end of each week. All air hammers should be returned every evening.

No method of handling tools, however good, will operate successfully without the hearty co-operation of department foremen who should keep watchful care of tools while in the hands of men under their jurisdiction.

DISCUSSION.

Various methods of obtaining an accurate check on tools were discussed. When checks are lost by the shop man, one tool room foreman gives him a set with a new number; another gives him a set with the same number but on a smaller check, so that the turning in of the larger and original checks can be caught. A system in vogue at one place is that of giving out new checks all around every six months. The general opinion seemed to be that boilermakers should be given ten checks with from five to eight to other shop men.

A man who is sent out on the road or to a terminal should be given the best tools available. From the discussion it was evident that some foremen were having trouble in keeping track of tools sent out in this manner. A. R. Davis (Cent. of Ga.) has standard metal boxes which are kept fully equipped with tools for men sent out on the road. They are locked with a padlock, the key for which is kept on the board. When a man is to go out on the road he is given the box and key, and the tool room has a complete check on his tools.

Sub-toolrooms came in for a share of the discussion, one member having a sub-toolroom for each pit gang. One member of the gang checks out the tools to his gang. A member stated that a central toolroom in a big shop resulted in a great loss of time and sub-toolrooms located in the boiler shop, machine shop and roundhouse were favorably commented on. One member was strongly in favor of having all of the tools of a toolroom, except the most valuable ones, in sight so that a man can get what he wants without pulling out drawers and looking under shelves.

Special Tools.

By J. J. Sheehan, N. & W. Ry., Roanoke, Va.

It does not necessarily follow that a tool because it is special must be complicated in its design. On the contrary, simplicity should be the controlling feature in its consideration.

The illustration shows an arrangement for cutting the jaws in locomotive side rods. A is the rod to be operated on, B is a pneumatic clamp which holds the rod A in place and C and C are inserted tooth, 30″ diameter saws. The saws are spaced the required distance to complete the operation, which is done in fifteen minutes from floor to floor.

By T. F. Eaton, B. & O. R. R., Baltimore, Md.

We use a special reamer for making one large hole in tube sheet so that tubes may be drawn out easily. This reamer is of the shell form with a No. 4 shank screwed into the back, 3″ long, tapped half-way back and $\frac{3}{32}$″ smaller at the front end. It is cut spiral with a lead of 60″ to one turn, $5\frac{11}{16}$″ diameter, has 25 teeth fluted with a convex cutter. For superheater heads we use a 45 degree reamer with a No. 2 Morse taper shank inserted to suit small air motor. These reamers are made from high speed steel, have 25 teeth and are ground with 6 degrees clearance. They are milled with a 60 degree cutter.

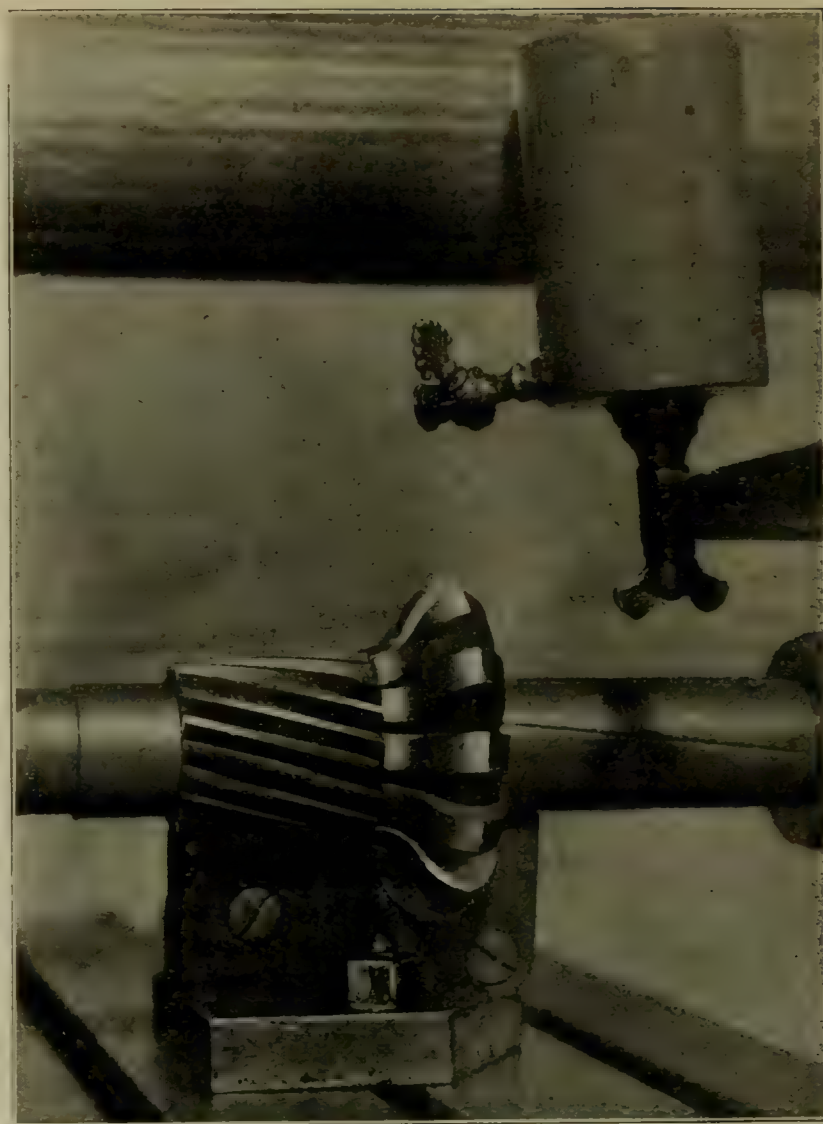
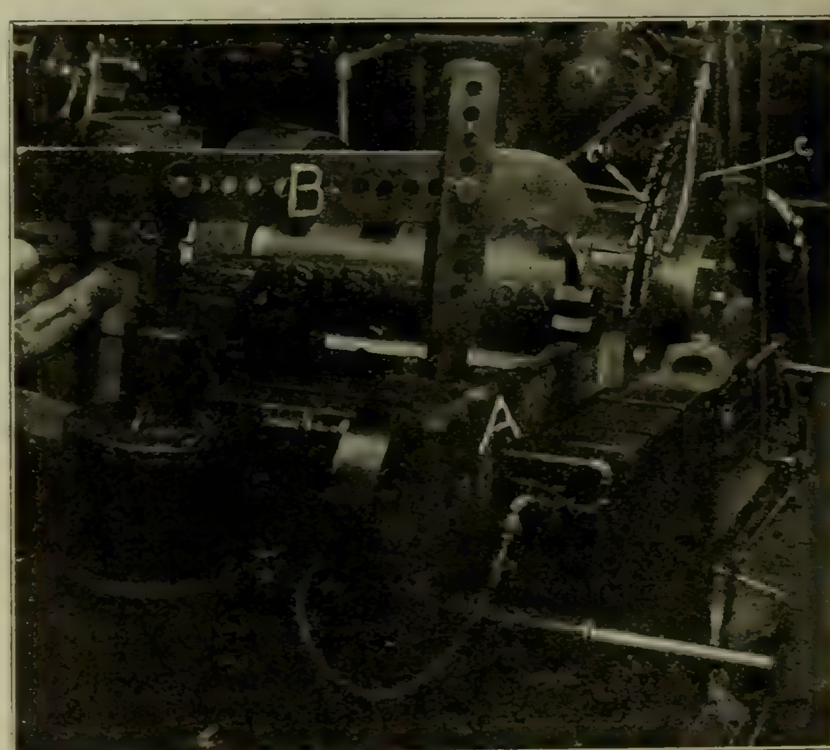


Fig. 1. Milling Cutter for Driving Tire Forming Tools.

By H. B. Miller, Big Four Ry., Beech Grove, Ind.

We were drilling arch tube holes $3\frac{1}{16}$″ from both sides, which was expensive. We made a special tool to drill both holes from the outside as follows: A machine steel body 14″ long was made to cover the widest water space. This had a No. 4 taper shank for use with air motors. The end was counterbored 1″ deep and had a $\frac{3}{8}$″ wall. The end is also drilled for a pilot which is fluted so as to be used in the staybolt holes. This cutter will bore both holes in four minutes and cost $2.05. The



Device for Cutting Jaws in Side Rods, N. & W. Ry.

blades are made of high speed steel and are inserted with a tongue and grove.

It has been the practice to use reclaimed high speed steel in inserted blade rose bit reamers for all sizes, but in making reamers under 1½″ diameter we have found it more economical to make them of carbon steel as the high speed blades were so much stronger than the bodies that the bodies were twisted, causing the blades to break.

By R. Dolensky, Southern Pacific Co., Dunsmuir, Cal.

(Mr. Dolensky submitted nine illustrations of various tools, a few of which are shown herewith.)

Fig. 1 shows a milling cutter designed for machining and resharpening high speed steel-forming tools for finishing driving wheel tires. The forming tool is annealed, bolted to the milling fixture as shown, milled and resharpened, being then ready for service on the driving wheel lathe. The milling cutter shown is made in two pieces, is of high speed steel and has been in service for four years.

Fig. 2 shows a fluted milling cutter for milling keyways through the back end of piston rods for crosshead keys. A ¾″ hole is drilled through the rod at one end of the desired keyway and the rod is then set up in the milling machine, the remaining keyway being milled out from the solid stock. The cutters having straight flues alternately nicked or broken has given the best service in this class of work, being capable of removing more stock in a given time than any of the spiral cutters. This cutter milled out a ¾″ keyway through a 4″ rod for a distance of 3¾″ in 55 minutes.

Fig. 3 shows various reamers for reseating ball joints between injectors and pipes leading to and from them. These reamers

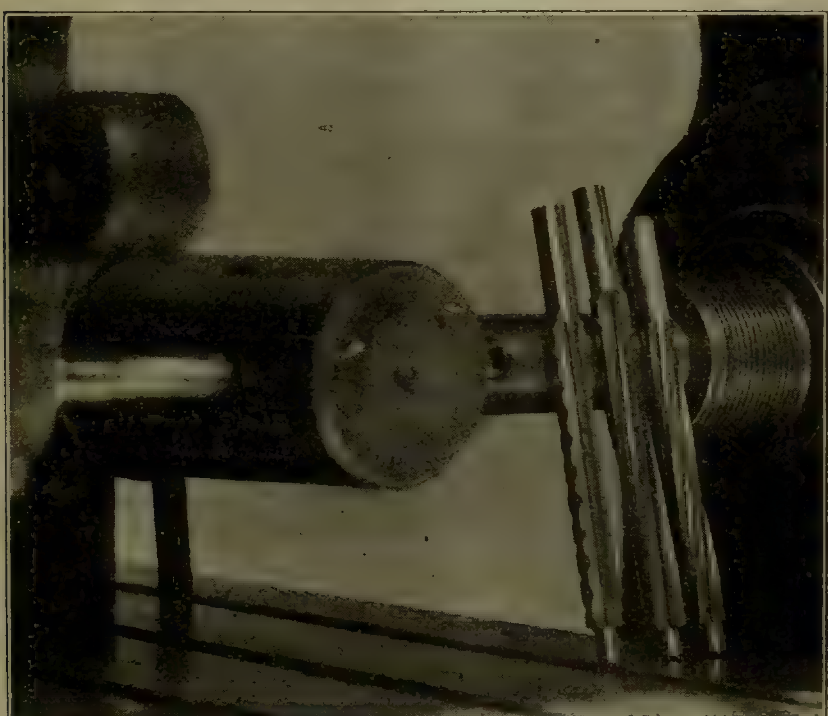


Fig. 2. Milling Cutters for Piston Rods.

are fitted with feed nuts and are used for refitting joints both in the shop and while the injector is on the engine.

(W. L. Stephenson, A. C. L. Ry., Rocky Mount., N. C., submitted seven sketches of various tools in use at his shop, but which we are unable to publish due to lack of space.)

By W. E. Goodwin, C. & A. Ry., Bloomington, Ill.

The illustration shows a special tool for cutting oil grooves in driving boxes, on the shoe and wedge bearing. The tool is designed with a tripple gearing with two cutters on each gear, and so arranged that the grooves will come together with a center ring. The tool has a roller bearing on each side to fit against the driving box jaw and keep it from turning.

DISCUSSION.

O. D. Kinsey (Ill. Cent.) stated that the wide spacing of teeth on cutters has doubled his milling machine work and at the same time produces a very smooth cut. He has increased the

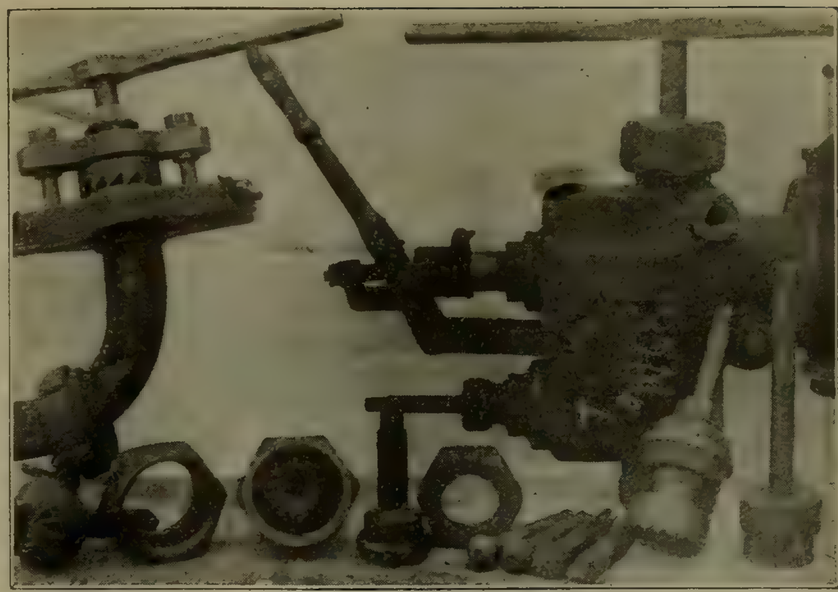


Fig. 3. Injector Reamers.

diameter of arbors from 1″ to 1½″, and is making slotting mills with a pitch of 30 degrees or more. Modern practice makes the cutting edge undercut from 5 to 10 degrees. A. R. Davis reported that a number of cutters for milling out rod jaws, having a 37½ degrees of the spiral, were proving very efficient.

Special Dies for Cold Work.

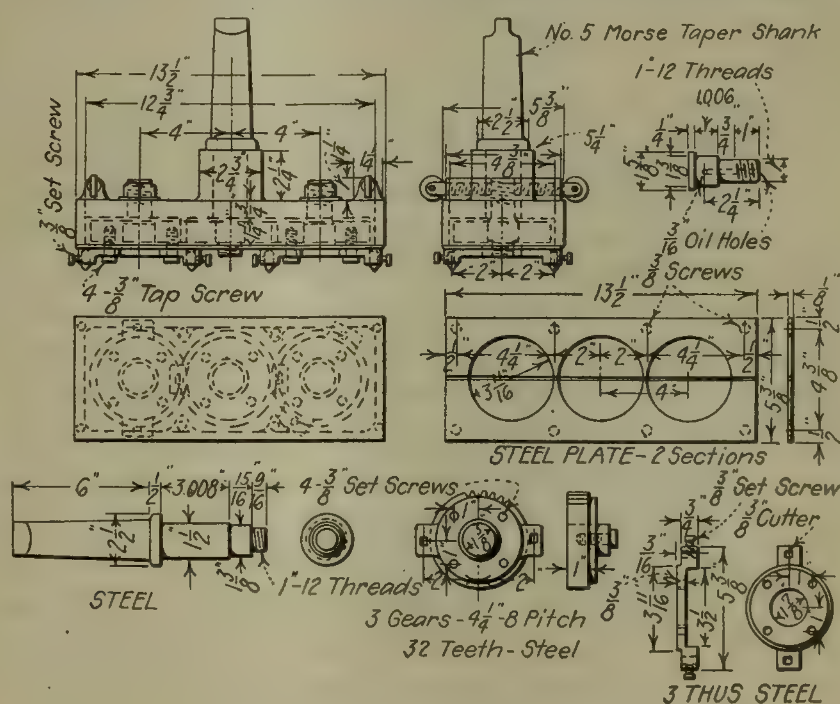
By B. Henrikson, Tool Foreman C. & N. W. Ry., Chicago.

Cold punching machines in use at the Chicago shops of the C. & N. W. might be divided into three classes, viz.:

1. Boiler sheet punching.
2. Sheet iron, copper and brass.
3. Leather and rubber.

Turning first to the dies used for boiler sheet punching, the first important caution to be observed is to get started right by choosing the proper kind of material. The best steel for this purpose is one of a low carbon content, about 85 points for both punch and die. Both punch and die are hardened and the temperature at which the hardening is done is determined by the carbon content. The temperature should be higher with low carbon content and lower with higher carbon content. The temperature should be approximately about 1,700 to 1,800 degrees Fahrenheit. Clearance should be allowed between the punch and die. For ordinary boiler punching on holes on ½″ diameter and greater, the hole in the die which receives the punch should be $\frac{1}{16}$″ greater than the diameter of the punch.

The next class of dies to be considered are those used to punch sheet iron, tin, copper and brass, and are commonly called blanking dies. This type of die should be preferably made of special steel of high carbon content, about 110 points. The



Device for Cutting Oil Grooves.

method of manufacture varies according to the type of die. Sometimes the die is forged to shape and sometimes made directly from stock. Tempering of these dies should be carefully done in order to avoid warping. Where dies are not too large and do not contain an excess of material in one spot, oil is used for tempering bath. In the case of heavy dies, however, the heat of the die causes the oil to bubble, thus forming air pockets on certain parts of the die. The effect of these air pockets is to prevent uniform cooling all over the surface of the die, and when testing the die will be found to be soft in spots. These air pockets can be done away with to a certain extent when using oil as the bath by giving the die an up and down motion while it is cooling. Where it is found that oil cannot be satisfactorily used, water is used for the cooling die. The electric furnace is generally used to heat the dies to the required tempering temperature which should be between 1,400 and 1,500 degrees. No clearance is allowed between the punch and the die. In the case of dies used on sheet iron, a slip fit should be allowed. Both punch and die should be hardened. In the case of dies used for punching tin the fit between the punch and die should be tight. The plunger is left soft only the die being tempered. By doing this it is made possible to upset the punch by hammering when either punch or die becomes worn.

The method of making leather and rubber dies is practically the same as that used in making blanking dies.

DISCUSSION

Tell-tale gauges, emery wheel dressers, beading tool gauges, etc., are being cold punched very successfully and at the same time enabling considerable scrap iron to be used up for this purpose. J. W. Pike is punching wheel defect gauges out of No. 14 polished steel, marking them after punching.

ASSOCIATION BUSINESS

The association voted to hold its 1915 convention at Chicago in the month of July. By vote of the members, F. J. Powell, a past president, was made an honorary member. A committee was appointed to report at the next meeting on the matter of an emblem for the association. The treasurer's report showed a slight deficit, which it is expected will be fully covered with the increased membership for the coming year, however. About sixty-five members were registered out of a total of ninety.

New officers were elected as follows: president, Henry Otto, A. T. & S. F. Ry., Topeka, Kan.; first vice president, J. J. Sheehan, N. & W. Ry., Roanoke, Va.; second vice president, C. A. Shaffer, Ill. Cent. R. R., Chicago; third vice president, J. C. Bevelle, El Paso & S. W. Ry., El Paso, Texas; secretary-treasurer, Owen D. Kinsey, Ill. Cent. R. R., Chicago. R. D. Fletcher, Belt Line Ry., Chicago, was elected chairman of the executive committee, and the following were appointed as members of the committee: B. Hendrickson, Chas. Helm, Geo. Nutt and Henry Welter.

WITHOUT WAITING for the report of the joint congressional committee, which has, for two years, been investigating the subject of railway mail pay, Congressman Moon had already introduced a bill which would still further reduce the pay and thereby extend the injustice to which the railroads are now subjected. The railroads have been claiming, and they still assert that they have proved to the joint congressional committee that they were already underpaid at least $15,000,000 a year for carrying the mail, and that no fair consideration has been given to the question of compensating them for carrying the parcel post. The railroads are prepared to abide by the conclusion of the joint congressional committee upon the fact as to whether or not they are now overpaid. They are also eager to coöperate with the government in arriving at a policy to govern future methods of payment which will protect the government, and at the same time secure to the railroads that pay to which they are justly entitled.

COMMUNIPAW TERMINAL FACILITIES, C. R. R. OF N. J.

By reason of demand for increased facilities for rapidly and economically handling locomotives, the Central Railroad of New Jersey has had constructed at Communipaw, N. J., a modern locomotive terminal which for its size, convenience and up-to-date construction is not excelled by any other plant in the country. The work was designed and executed by Westinghouse Church Kerr & Co., engineers and constructors, New York City, in coöperation with and under the direction of Joseph O. Osgood, chief engineer, and A. E. Owen, prin. asst. engineer, of the Central of New Jersey.

The new plant is located on the south side of the main line tracks about one mile west of the passenger terminal and is in close proximity to the freight yards, which are located on the opposite side. Located with the freight yard on the one side and the passenger yard on the other, the terminal facilities are arbitrarily divided so that the freight and passenger engines are handled separately.

The sufficient track arrangement provides the necessary flexibility to permit of the free use of either of the houses for passenger or freight as may be found necessary or desirable. It has been possible to provide a layout of tracks, leading up and into the terminal, especially designed for the quick handling of passenger power, formerly cared for in the two old engine houses at Fiddlers and Communipaw, located on the north side of the main track, and through which were handled 30,823 locomotives during the first four months of the present year, or an average of 255 locomotives per day. During the summer months the number of engines handled per day is about 300, which includes all the usual performances of cleaning fires, dumping ashes, coaling, supplying sand and water, washing boilers and inspecting, together with any light running repairs that may be necessary.

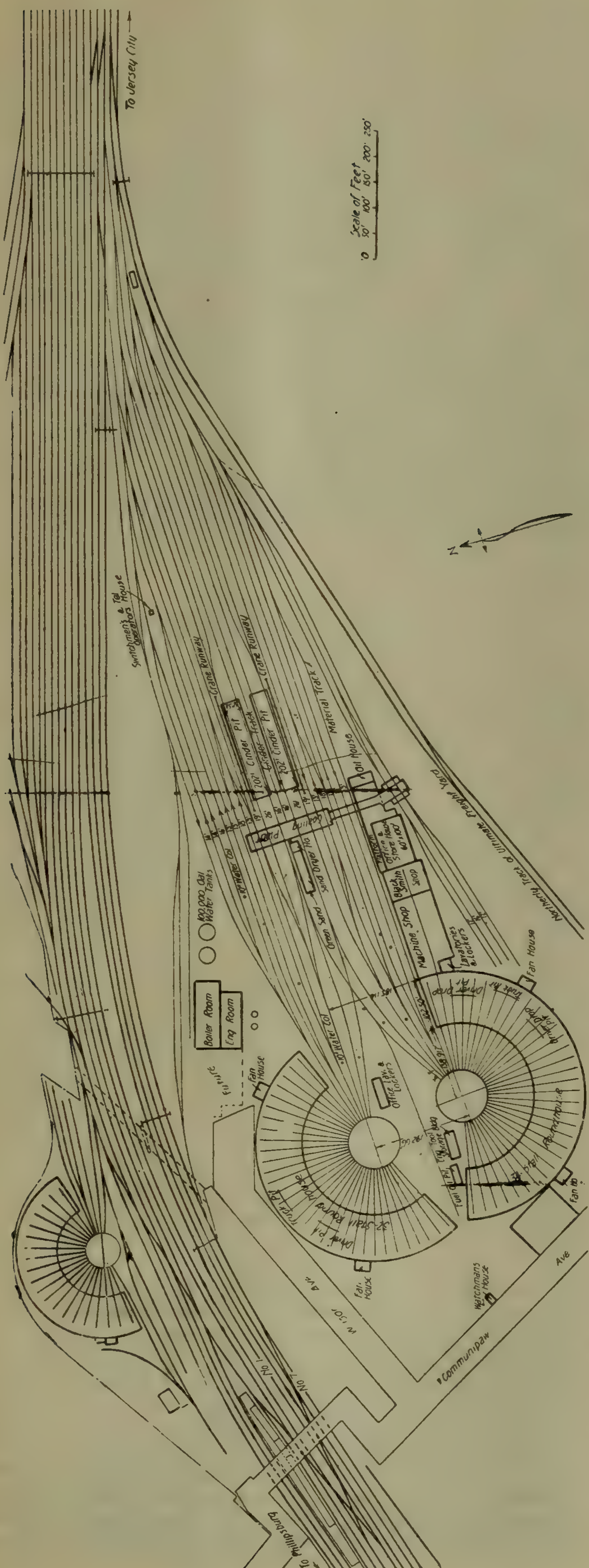
These completed improvements consist of a power house to serve not only the engine terminal but also to take care of all electrical requirements of the railroad from the Jersey City water front to Newark Bay. Two roundhouses, one 34-stall, 100 ft., and one 32-stall, 90 ft., two 100-ft. turntables, machine shop, blacksmith shop, storehouse and office, material platform, oil house, cinder pits, coaling station, sand storage, roundhouse office and toilet building, engineers' locker building and telephone tower, with all equipment and service inside of building and in yard.

The ground is principally cinder fill, varying in depth from two to ten feet, on an underlying strata of blue clay, sand and bog, except where the old shore line runs across the west end of the property. In consequence all the buildings rest on piles with the exception of the west half of the roundhouses, where the ground conditions are favorable for footings. The foundations of the buildings consist of concrete pile caps and piers where the concentrated loads are imposed, with reinforced concrete wall girders supporting the building walls. The power house, however, rests on a concrete slab 4 ft. thick, extending under the entire building. This slab is supported on piles spaced equally under the entire mattress. All the buildings are constructed of reinforced concrete, steel and brick with steel sash, wooden doors and concrete floor. The roofs of all buildings except coaling station are covered with three-ply asbestos felt roofing.

POWER HOUSE.

The power house is 135 ft. long and 92 ft. wide, with concrete boiler and machine foundations. The building proper is of brick with a structural steel frame for supporting boilers, stack and coal bunkers. Steel sash and doors are used.

Six 250 hp. B. & W. water tube boilers arranged in three batteries of two each are installed, and space is provided for an additional battery. Boilers are fed by two reciprocating, duplex, outside end packed, plunger type pumps, either of which is capable of furnishing the maximum amount of water needed for the boiler plant. Stokers are installed. A lined steel stack 10' 6" in diameter and 75 ft. in height above the roof furnishes natural draft, aided by automatically controlled turbine type blowers. Feed water and steam piping are of the loop type. A Cochrane feed water heater provides feed water at a temperature of about 200°.



Layout of Communipaw Terminal.

Power House and Water Tanks.

Hopper bottom cars deliver coal into a track hopper; the coal is then elevated by bucket elevator, discharging into a flight conveyor which distributes the coal into the bunkers located over the boiler room. The coal is fed by gravity to the stokers through chutes with gates operated from the boiler room floor.

Ashes are dumped from the stoker into a hopper directly underneath. The hopper terminates in a gate. A bucket on a car traveling on an industrial track is manually pushed underneath the hopper, loaded by gravity with ashes and then manually shoved to a point below an electrically driven hoist, which elevates the bucket and automatically dumps it into a hopper above the railroad siding. Ash and coal handling arrangement is such that the railroad car is used to bring in coal and load with ashes without changing its position.

Three 600 kw. 2200 volta.c. General Electric turbo-generators are installed with space provided for a fourth unit. One steam driven exciter and one motor driven exciter are installed. Two 2500 cubic ft. compound steam two-stage air compressors furnish air for the engine terminal, also for operation of switches and signals in terminal yard between Communipaw and Jersey City and to Elizabethport and Newark on the main line and on Newark branch.

The plant operates normally condensing; in cold weather the exhaust steam is used for heating the several buildings in the terminal. A mixing condenser is located in the engine room basement. As the water used for condensing purposes is taken from the Jersey City mains and metered, condensing water is cooled in a cooling tower and used over again. An automatically controlled motor driven centrifugal pump located in the basement of the plant is used for raising water into elevated tanks when necessary. There is also a 1500-gallon underwriters' pump connected onto high pressure fire lines in yard and buildings. Jacket circulating water is returned to the water system through a duplex steam pump.

The main switchboard is located on the engine room floor with high tension switches in the basement where the transformers are located. Current is generated at 2250 volts and stepped down to 550, 220 and 110 volts for use at the terminal proper.

A ten-ton Maris hand-power crane spans the engine room floor.

ROUNDHOUSES.

The roundhouses are constructed of reinforced concrete columns, piers and roof girders, with hollow tile and concrete roofs. The rear wall consists of concrete piers approximately 5 feet wide with steel sash between, with an 8-inch brick wall below these windows. This arrangement permits a maximum window space both for lighting and ventilation. The roof line is broken at the first row of columns at the front of the building so as to give a row of hinged sash over each stall. Additional ventilation is provided for by means of three-chamber four-inch hollow tile set in the rear wall above the windows and in the locomotive door lintels. There are also ventilating openings above the sash in the roundhouse monitors. This arrangement follows Central R. R. of New Jersey standard practice and provides an outlet for any gases that may collect

Machine Shop and Round House.

underneath the ceiling, which is a flat arch, giving an unobstructed path for gases to pass out through the ventilator openings. Both houses are heated by the indirect system. The fans and heaters are located in the fan houses, of which there are two in each house. The hot air is delivered through underground ducts and is discharged through outlets located in the pits and around the rear wall. The floor wearing surfaces are concrete throughout and are reinforced along the sides of the pits to provide bearing for jacking. Each house is provided with steam, air and water service on columns.

In addition a boiler washing plant has been installed in connection with the 90 ft. house, which serves 32 stalls. The piping is of such size as to permit of the system being extended to the 100-ft. house should it be desired at a later date.

Asbestos smoke jacks are at present installed, but the roofs of the houses are so designed and constructed that they could sustain the weight of cast-iron jacks should it be found desirable to install them in place of the asbestos jacks.

Both houses are lighted by Tungsten lamps, the wires being carried in conduits under floors and in columns. There is installed in the 90-ft. house one driver and one truck drop pit, and in the 100-ft. house two driver and one truck drop pit, each extending over three stalls, which have pneumatic jacks for wheels and half-ton crane for handling driver boxes, etc.

The entrance doors to the stalls are hinged to lintel posts, which are entirely separate from the building construction proper, and so fastened to the building columns that the accidental wrecking of a door will not damage the building structure.

TURNTABLES.

Each roundhouse is served with 100-ft. deck turntable of heavy construction operated by Nichols' electric tractors. Owing to the extreme depth of these turntable pits and the shallow grade of the sewer in the vicinity, it was found necessary to provide against the contents of the sewer backing up into these pits. This was accomplished by constructing a deep sump into which both pits are drained. Automatic ejectors discharge this drainage into the nearest sewer at a higher level.

MACHINE SHOP AND BLACKSMITH SHOP.

Adjoining and directly connected to the 100-ft. roundhouse is the machine and blacksmith shop building. The total length is 200 ft. and the total width 80 ft., and the height is 28 ft. over all.

A monitor 13 ft. wide extends over the entire length of the building and is provided with continuous top-hunt steel sash, operated from the machine shop floor. Toilet and locker room facilities are provided in a small extension located between the main building and the 100 ft. roundhouse. Access to this toilet room and locker room may be gained either from the machine shop or the roundhouse.

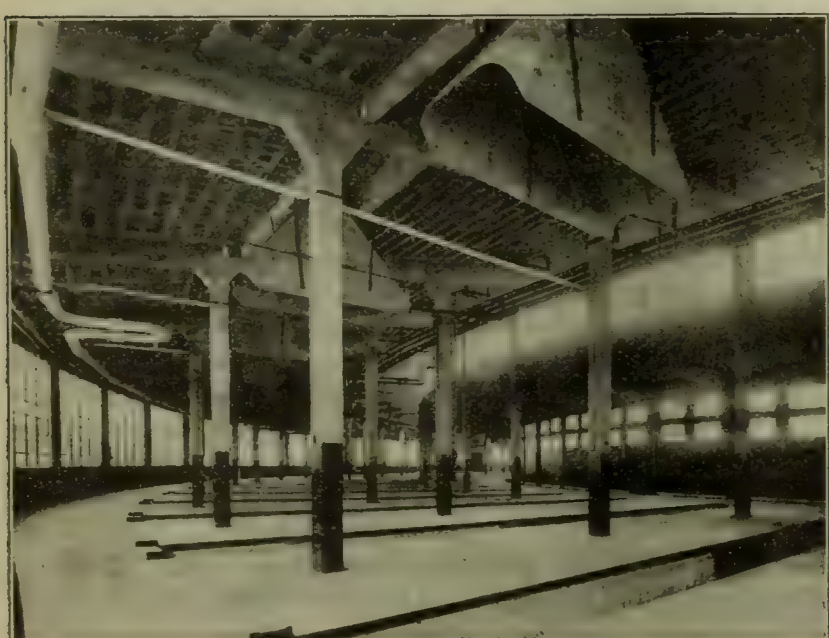
The machine shop space is 140 ft. long by 80 ft. wide and has a concrete floor throughout. The equipment consists of small lathes, crank planers and other similar machines as may be required for light running repairs. Two motor driven line shafts near the north wall furnish power for the small machines, a motor driven wheel lathe for driving and truck wheel work is located near the center of the building and is served by a four-ton overhead trolley. One of the roundhouse tracks is extended through the machine shop into the blacksmith shop.

In the southeast corner of the machine shop space is provided for pipe work. Besides two pipe forges, this space contains an 8-inch pipe machine, pipe racks, benches, etc.

The blacksmith and boiler shop is located at the east end of the building and is separated from the main or machine shop by a fireproof wall. This space is 40 ft. wide and 80 ft. long and the south half is occupied by the blacksmith shop, which is equipped with five down draft forges, each served with a half-ton jib crane. A 2000 lb. steam hammer served by a three-ton jib crane is located in the center of the blacksmith shop space. The equipment of the boiler shop consists of motor driven punch and shears, hand-bending rolls, flangefire and screw flanger. Heating of the building is by direct radiation and lighting by Tungsten lamps varying from 25 to 500 watts. A concrete ramp is located at the northeast corner of the building. This leads to the material platform by means of which material may be brought directly to the machine and blacksmith shops from the storehouse.

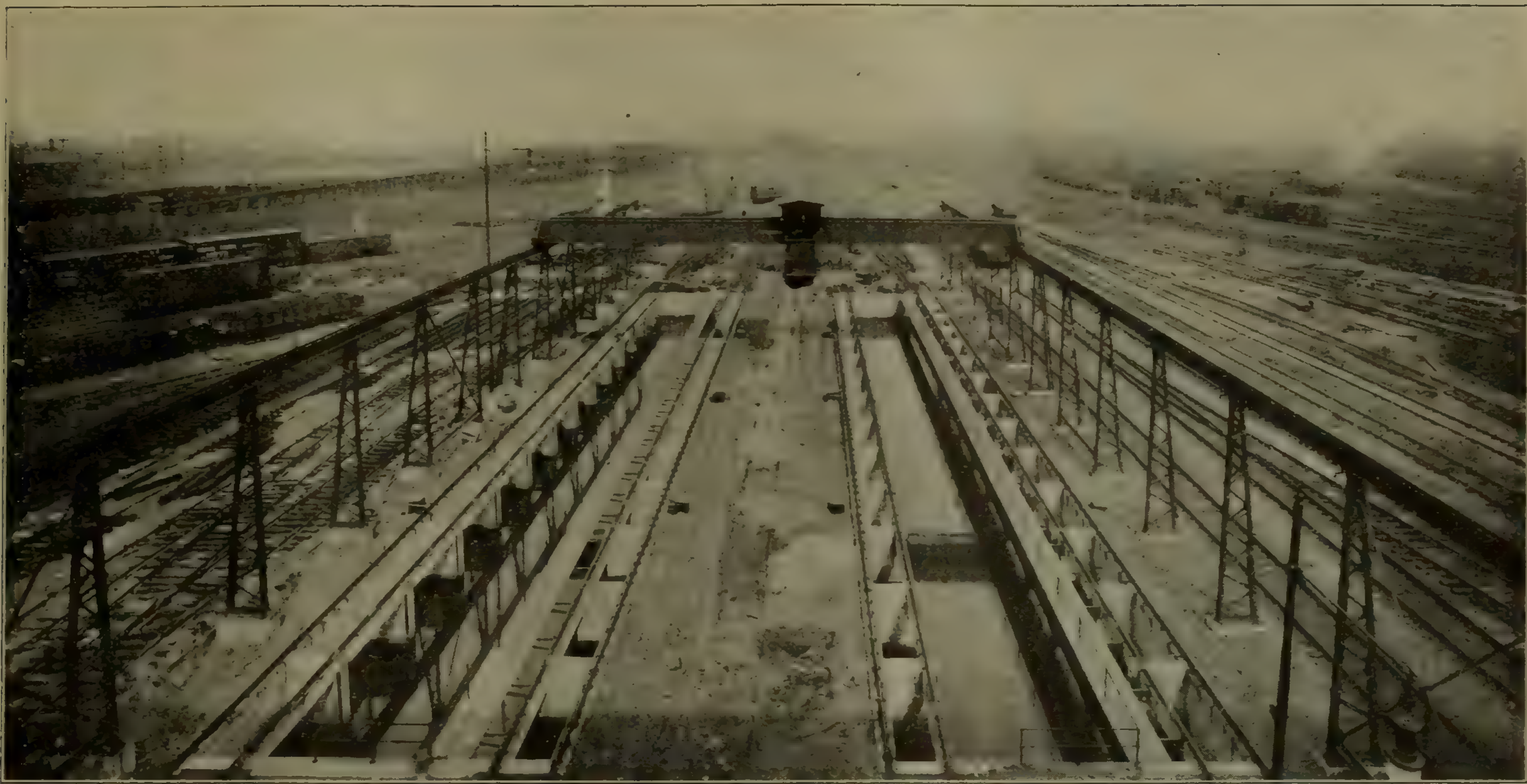
STOREHOUSE AND MATERIAL PLATFORM.

The storehouse is 100 ft. long and 60 ft. wide and directly adjoins the blacksmith shop building. Its construction is fireproof throughout. Steel bins and counters are used for storing material, so that except for any combustible contents the fire hazard is reduced to a minimum. The building is at present one story in height, but the foundation, walls and columns are designed heavy enough for a second story should it be found necessary to construct this addition at a later date. The easterly end of the building is divided by fireproof partitions into offices for the general foreman and the storekeeper and the toilet and wash room. The material platform is 48 ft. wide and 80 ft. long and extends 12 ft. in width along the north side of the storehouse.



Interior of Round House.

Concrete Coaling Station.



Submerged Cinder Pits, with Traveling Crane.

This structure is built of reinforced concrete and hollow tile with concrete wearing surface.

OIL HOUSE.

For the storage of various kinds of oil used at the engine terminal an oil house is located at the extreme east end of the material platform. This building is 20 ft. wide, 48 ft. long and one story in height, and is provided with a basement 10 ft. high in which the various oil storage tanks are located.

The measuring pumps and boxes for filling the storage tanks are located on the main floor, where space is also allowed for storage of waste and grease cakes. The building is lighted by Tungsten lamps and heated by direct radiation at a high temperature to render the oil fluid in cold weather.

COALING STATION.

The most interesting structure of the group, on account of its size and construction, is the coaling station. The main building spans eight tracks and serves an additional track at each end. The structure is 168 ft. long, 34 ft. wide and 55 ft. high, and is of reinforced concrete throughout. The bunkers rest on special steel I-beam girders encased in concrete, and the hopper bottoms are built of reinforced concrete with hollow tile. The sides of the bunkers are heavily reinforced to withstand the side pressure of the coal when the bunkers are filled. A monitor extending the full length of the structure is of steel trusses with 2 in. plastered concrete sides and is provided with an asbestos roof. The coal is received from the cars by two receiving hoppers, from which it is discharged by means of reciprocating feeders into bunkers conveying elevators. These conveying elevators carry the coal to the top of the hopper house, where it is discharged on two 30-inch belt conveyors running up the conveyor bridge over the top of the bunkers. Traveling trippers running on rails above the bunkers discharge the coal into various compartments.

There are three longitudinal bunkers having a capacity respectively of 430 tons of bituminous, 813 tons of broken and 430 tons of buckwheat coal. These bunkers are each divided into four compartments by transverse concrete partitions. Each track is served by three coal chutes so that an engine on any one of the ten tracks may be coaled with either bituminous, broken or buckwheat coal. The conveying machinery is divided into two separate and distinct units from the track hopper to the tripper over the bunker, each unit having a conveying capacity of 100 tons per hour. Provisions are made, however, whereby either track hopper elevator or conveyor of one unit may discharge its contents into the elevator or conveyor of the other unit, and in addition the trippers are so arranged as to discharge into either one of the three bunkers. This flexibility reduces the possibility of shutting down the entire plant, due to a breakdown or other emegrency to a minimum. The entire machinery is electrically driven.

Suitable stairways, platforms and walkways are provided, from which an inspection of the apparatus may be safely made while the machinery is in operation. Guards are placed over all exposed gears as a protection to the attendants, and in addition there are 11 emergency stations from which the entire machinery maybe shut down by pressing a button.

West of the coaling station and south of the machine shop and storehouse are the coal storage tracks, having a capacity of forty cars. Provisions are made for thawing out frozen coal in the cars on these tracks by means of live steam.

Under the center bay of the coaling station at the ground level there is a toilet and locker room for use of hostlers, cinder pit and coaling station employees.

SAND HOUSE.

Provisions for the storing and drying of sand are made in a building west of the coaling plant. This building is of reinforced concrete throughout and is 103 ft. long, 16 ft. wide and 14 ft. high. The green sand is dried by means of two coal stoves of standard Central R. R. of New Jersey design, located in a separate room in the east end of the building. The dried sand is then screened and elevated by means of compressed air to two storage tanks of 15 cubic yards capacity each, located on top of the coaling station. From these tanks the sand is delivered to the locomotive through cast-iron delivery pipes and wrought-iron telescoping spouts serving each of the ten tracks.

CINDER PITS.

The cinder pits are located about 60 ft. east of the coaling plant and are of the submerged type. They are each 200 ft. long, 30 ft. wide and 12 ft. deep, and are heavy reinforced concrete throughout.

Each pit serves two tracks which are 26 ft. center to center. The pits are parallel and are about 58 ft. center to center with a track for cinder cars between. The cinders are cleaned out of the pits by a four-ton electric traveling crane operating a 1½ yd. clam-shell bucket. This crane is located on a steel runway 240

ft. long, 99′ 6″ span and 26 ft. above the rail. Aside from the economy and speed in handling engines over the pit, this arrangement permits of the coaling of engines from cars by means of the clam-shell bucket should occasion arise.

MISCELLANEOUS BUILDINGS.

Among the miscellaneous buildings are the engineers' tool storage building and the roundhouse toilet and office building. These buildings are 20 and 22 ft. wide and 55 ft. and 52 ft. long, respectively.

Both buildings are heated by direct radiation and lighted by Tungsten lights. The engineers' tool storage building is equipped with steel lockers of special design for storing the locomotive engineers' tool chests, etc.

The roundhouse office and toilet building is divided by a tile partition into an office room at the east end and toilet and locker room with steel clothes lockers and toilet facilities at the west end. The building is so situated that an unobstructed view of all inbound and outbound tracks in the terminal yard is obtained by the engine dispatcher in the office.

The telephone tower is located at the east end of the yard and the operator has full view of all outbound engines so that he can notify the tower man as to their location. This is a wooden building with the operator located on the upper floor.

TUNNEL.

A tunnel is provided from the power house to the roundhouse for carrying all steam, air and water service piping, and in addition all wires and cables for light and power in the buildings. This tunnel is of heavy reinforced concrete construction, waterproofed, and is 6 ft. wide, 7 ft. high and 367 ft. long, with a branch 60 ft. long running to the 90 ft. house. The tunnel is well lighted and affords ample working space for making repairs.

WATER SERVICE.

The water piping is divided into two systems. The supply is taken from a 16-inch water main of the Jersey City water service and is discharged by city pressure through altitude valves into two 100,000-gallon steel elevated tanks and then through the low or service system of piping to eight water columns in the yard for filling engine tanks and also into all of the buildings for general use.

A high pressure system of piping is carried around the property and into the various buildings from the fire pump in the power house for fire protection.

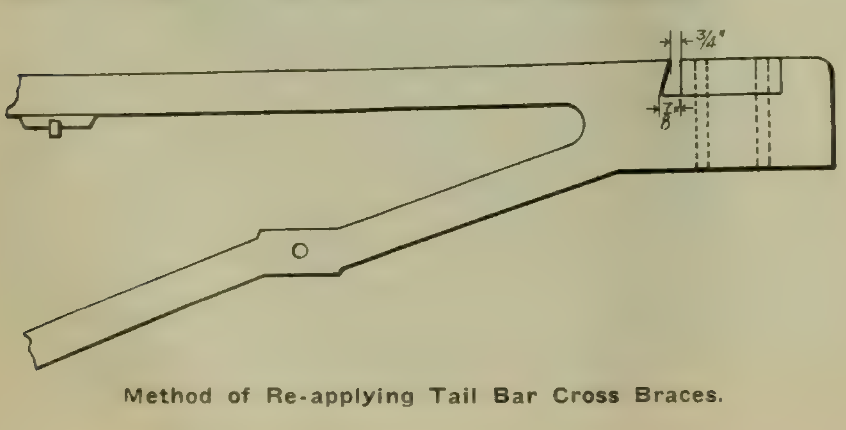
SEWERS.

A complete system of sewers has been installed to take care of all roof drainage and all drainage from engine pits, power house, toilets, turntables, etc., and in addition catch basins have been installed throughout the yard for track drainage.

YARD LIGHTING.

The engine terminal yard is lighted throughout by fifteen 125-volt alternating current flaming arc lamps. Four of these lamps are suspended from reinforced concrete poles located around the inner circle of the roundhouses, the remainder being suspended from tubular steel poles located at convenient points. Provisions are made for lowering these lamps to the ground for trimming. All conduits and wires supplying current for this lighting are underground.

Fuel oil is piped from an oil pit of 8,000 gallons capacity located between the west ends of the two roundhouses.



Method of Re-applying Tail Bar Cross Braces.

METHOD OF APPLYING TAIL BAR CROSS BRACES.

By H. C. Spicer, Fmn., A. C. L. R. R.

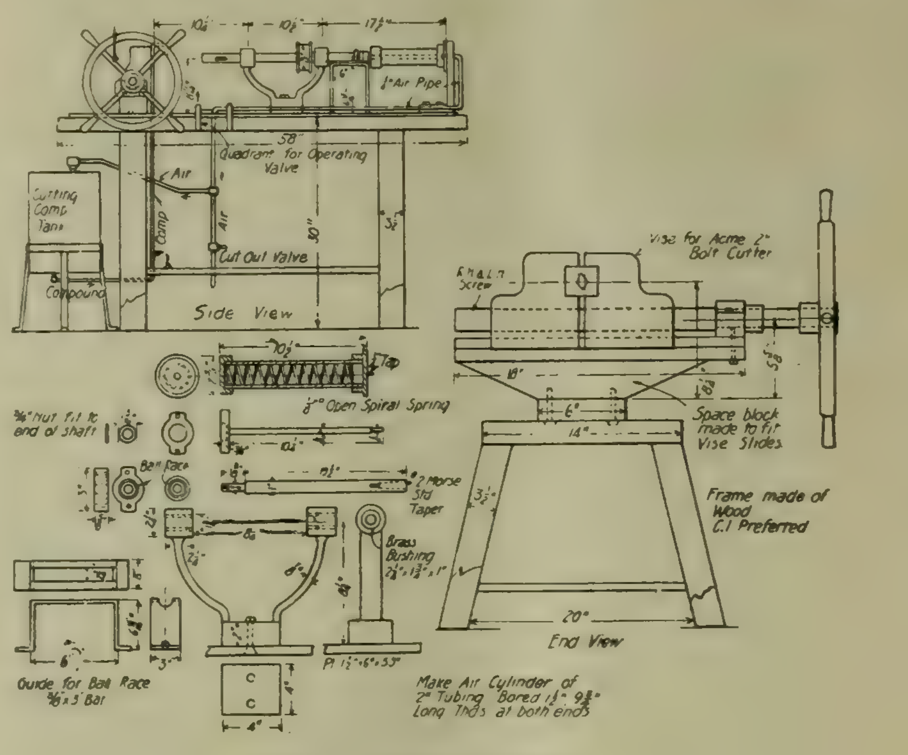
This is a very economical method of applying tail bar cross braces when locomotives are undergoing repairs in the back shop. It is very essential that this bar be kept tight at all times if we expect to get the proper service out of our power. At present we have to remove deck and all bolts, take the bar to the blacksmith shop to be built up, back to the machine shop to be planed and then fit and drive it into the frame. This bar very often becomes loose after the engine has been in service for a short time. The present method of applying it is a very expensive one and one which does not to my experience give the best results.

If the bar be applied as shown in sketch by applying a wedge-shaped key ¾″ at top and ⅞″ at bottom, fitted and driven in tight, there will be no more trouble with loose tail bars. Even if the key did become loose it could be very easily removed and a new key fitted in tight at the roundhouse, thus saving time and labor in removing decks. Too much attention cannot be paid to tight frame bolts, braces and cylinders. If this is given proper attention there will be no trouble in getting the satisfactory mileage.

CENTER DRILLING MACHINE.

By J. A. Jesson.

The center drilling machine shown in the illustration was designed by B. A. Givens, machine shop foreman of the Louisville & Nashville shops at Etowah, Tenn. It is used principally for drilling tell-tale holes in staybolts and will average about ninety per hour. In addition to this it will center stock up to three and



Center Drilling Machine.

a half inches in diameter. The machine is self-centering, and as it has an air cushion feed there is no danger of breaking the drills. For centering we use a No. 98 combination drill and countersink, manufactured by the Cleveland Trust Drill Co. The driving belt for the machine travels over a pulley on the countershaft seven inches long.

The twenty-second annual convention of the International Railroad Master Blacksmiths' Association will be held at the Hotel Wisconsin, Milwaukee, Wis., on August 18, 19 and 20. The subjects to be covered are live ones and everything indicates that the association will have the most profitable meeting it has ever held.

CONSOLIDATION LOCOMOTIVES, WESTERN MARYLAND RAILWAY.

Twenty consolidation locomotives having a tractive power of 61,300 pounds were recently delivered to the Western Maryland Railway by the American Locomotive Company. These locomotives were built to give the greatest possible tractive power obtainable within the axle load limitations.

The mechanical department of the railroad, after carefully studying the physical conditions of the division, decided that the comparatively low factor of adhesion of 3.55 could be safely used. By the use of this factor of adhesion and a driving wheel 51 inches in diameter, the tractive power of 61,300 pounds was obtained without sacrificing boiler capacity. It is therefore very interesting to note the wonderful work these engines are doing. It also proves the possibilities of this type of engine with a relatively small driving wheel for service where speed does not become a factor.

After leaving Cumberland, eastbound, the line runs over an undulating profile, on which the maximum grade against eastbound traffic is 0.3 per cent, for 74 miles to Williamsport, Md. From here it rises on a 1 per cent grade into Hagerstown, about 6 miles. On this division the railroad figured these consolidations to haul 4,725 tons.

On May 20th one of these consolidations left Cumberland at 2.30 A. M. with 114 loaded cars, weighing 7,014 tons, and arrived at Williamsport at 9:18 A. M. At this point 15 loads were set off and the train was given two Mallet helpers, leaving at 10:04 A. M. and arriving at Hagerstown at 11:05 A. M., having been on duty from the time they were called until released at Hagerstown, 8 hours and 35 minutes. Many such runs have been made since this time and it is now getting to be common. The astonishing fact to every one is the overload which these engines take care of.

Such heavy trains demand exceptional boiler capacity. The boiler is of the straight top type. It is 82 inches in diameter at the front end and 87 inches in diameter at the largest course. The barrel is fitted with 239 tubes 2¼ inches in diameter, 36 flues, 5½ inches in diameter and 15 feet 3 inches long. The tube spacing is 13/16 inch. The firebox is 110 inches long and 80¼ inches wide, and has a throat depth of 22 inches; measuring from the top of grate to the center of lowest tube.

According to the American Locomotive Company's new ratios, 25 inch cylinders with 200 pounds pressure gives a cylinder horse power of 2,252. One horse power hour requires 20.8 pounds of superheated steam. Total steam required per hour equals 2,252 x 20.8 or 46,840 pounds. Firebox and firebox water tubes have an evaporation of 55 pounds of steam per square foot of heating surface. Tubes 2¼ inches in diameter, 15 feet 3 inches long, spaced 13/16 inch have an evaporation of 10.605 pounds per square foot of heating surface; and flues 5½ inches in diameter, 15 feet 3 inches long, spaced 13/16 inch, have an evaporation of 11.625 pounds per square foot of heating surface. This boiler has a heating surface for firebox and firebox water tubes of 228.5 square feet, for tubes of 2133.7 square feet, and for flues 785.6 square feet. The evaporation for firebox and water tube is 228.5 x 12.570 pounds; for tubes, 2133.7 x 10.605 or 22,630; for flues, 785.6 x 11.625 or 9,200 pounds; giving a total evaporation of 44,330 pounds. The evaporation of the boiler, 44,300 divided by the evaporation required, 46840, gives a 95 per cent boiler.

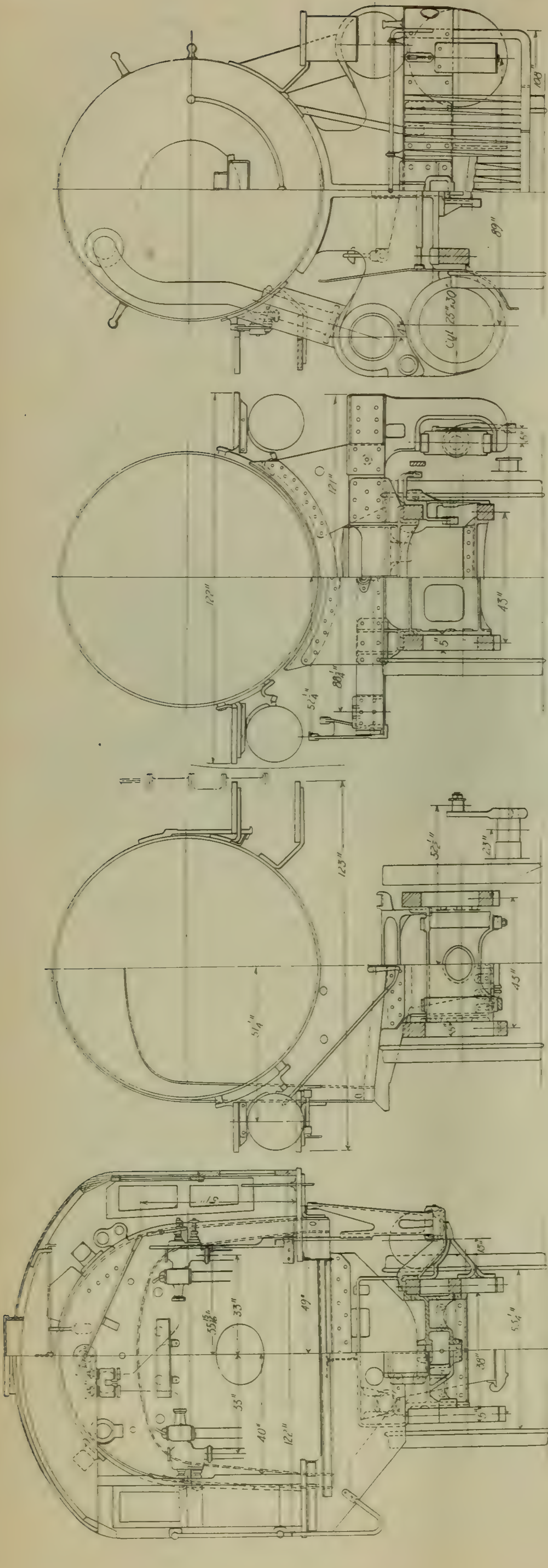
Maximum cylinder horse power would not be reached until this engine was running 31 miles per hour. As the service in which these engines are working will not require any such speed, a 95 per cent boiler will have ample steam making capacity. H. R. Warnock, superintendent of motive power, states that "with the poorest quality of coal I have ever seen, the fireman had no trouble in putting up the second pop; and it makes no difference how long you full stroke this engine, there is always 200 pounds of steam on hand."

This design was developed by the mechanical department of the Western Maryland in co-operation with the American Locomotive Company as a part of the program of this road in reducing operating costs. Interesting details included are the Baker valve gear, firebrick arch, superheater, outside steam pipes, Woodard engine truck, long main driving box, Foulder main rod and vanadium cast steel frames.

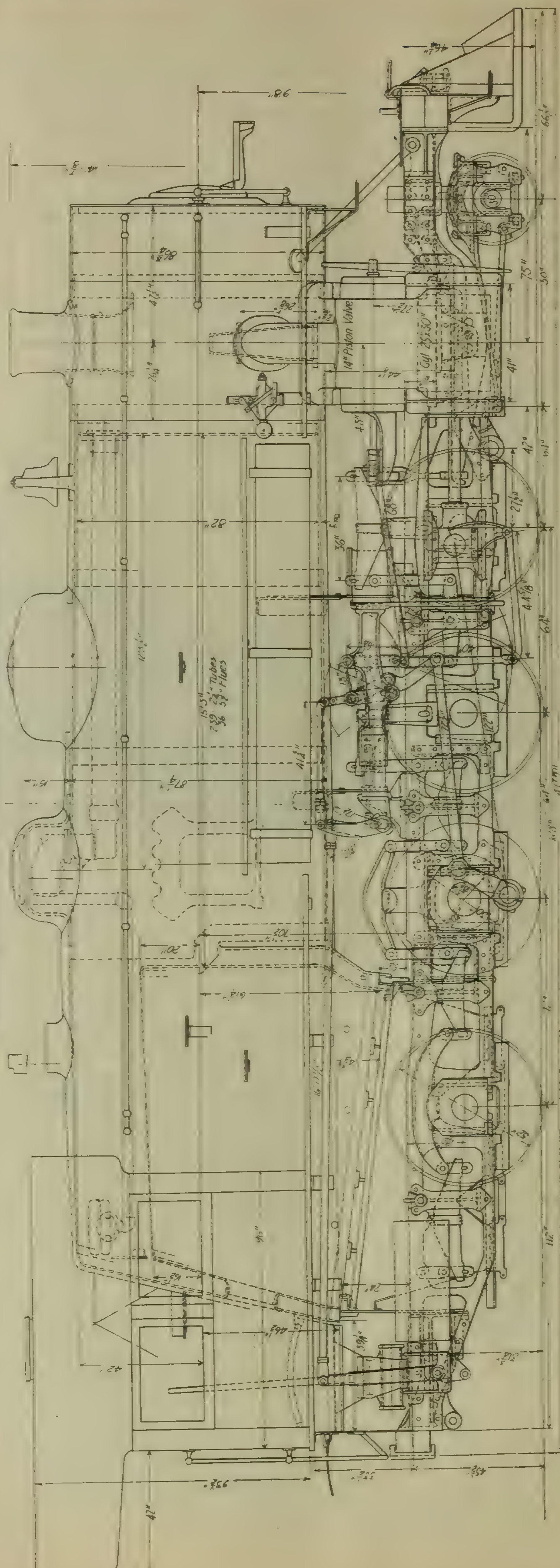
Consolidation Locomotive, Western Maryland Ry.

The principal dimensions are as follows:

Gauge	4'-8½"
Cylinders	25" x 30"
Valves	Piston
Tractive power	62,500 lbs.
Factor of adhesion	3.52
Boiler—	
Type	Straight top
Diameter	83¾"
Working pressure	200 lbs.
Fuel	Soft coal
Staying	Radial
Firebox—	
Length	111"
Width	80¼"
Thickness of sheets, sides	⅜" sides
Thickness of sheets, back	⅜" back
Thickness of sheets, crown	⅜" crown
Thickness of sheets, tube	½" tube
Water Space—	
Front	4½"
Sides	4"
Back	4"
Tubes—	
Material	Spellerized steel
Diameter	5½" and 2¼"
Thickness	5½", No. 9 BWG 2¼", No. 11 BWG



Section of Consolidation Locomotive, Western Maryland Ry.



Elevation of Consolidation Locomotive, Western Maryland Ry.

Number	5½", 36; 2¼", 239
Length	15'-3"
Heating Surface—	
Firebox	202 sq. ft.
Tubes and Flues	2919.3 sq. ft.
Arch tubes	26.5 sq. ft.
Total	3147.8 sq. ft.
Superheating surface	594.4 sq. ft.
Grate area	61.3 sq. ft.
Driving Wheels—	
Diameter, outside	52"
Diameter, center	45"
Journals, main	11" x 20"
Journals, other	9" x 12"
Wheel Base—	
Driving	16'-8"
Rigid	16'-8"
Total engine	26'-2"
Total engine and tender	68'-0"
Weight—	
In working order	244500 lbs.
On driving wheels	217500 lbs.
On trailers	
On engine truck	27000 lbs.
Total engine and tender	424000 lbs.
Tender—	
Wheels, number	8
Wheels, diameter	33"
Journals	6" x 11"
Tank capacity	9500 gals.
Fuel capacity	14 tons

BRASS FURNACE.

By Daniel Freuler.

In the preparation of this article it has not been my purpose to give to the readers of the *Railway Master Mechanic* something that is new but merely to show what can be done with some material that in the course of events might go on the scrap heap, thus utilizing other material for different purposes and in this way adding to the equipment useful and money-saving appliances. We had at the Memphis, Tenn., shops of the Illinois Central a brass furnace to take care of emergency cases. This furnace was an oil furnace and would melt brass all right but it would also melt the molder if he remained within a radius of fifteen feet of the furnace while melting a charge of brass, and especially in the limited room allowed for the brass foundry, as was the case.

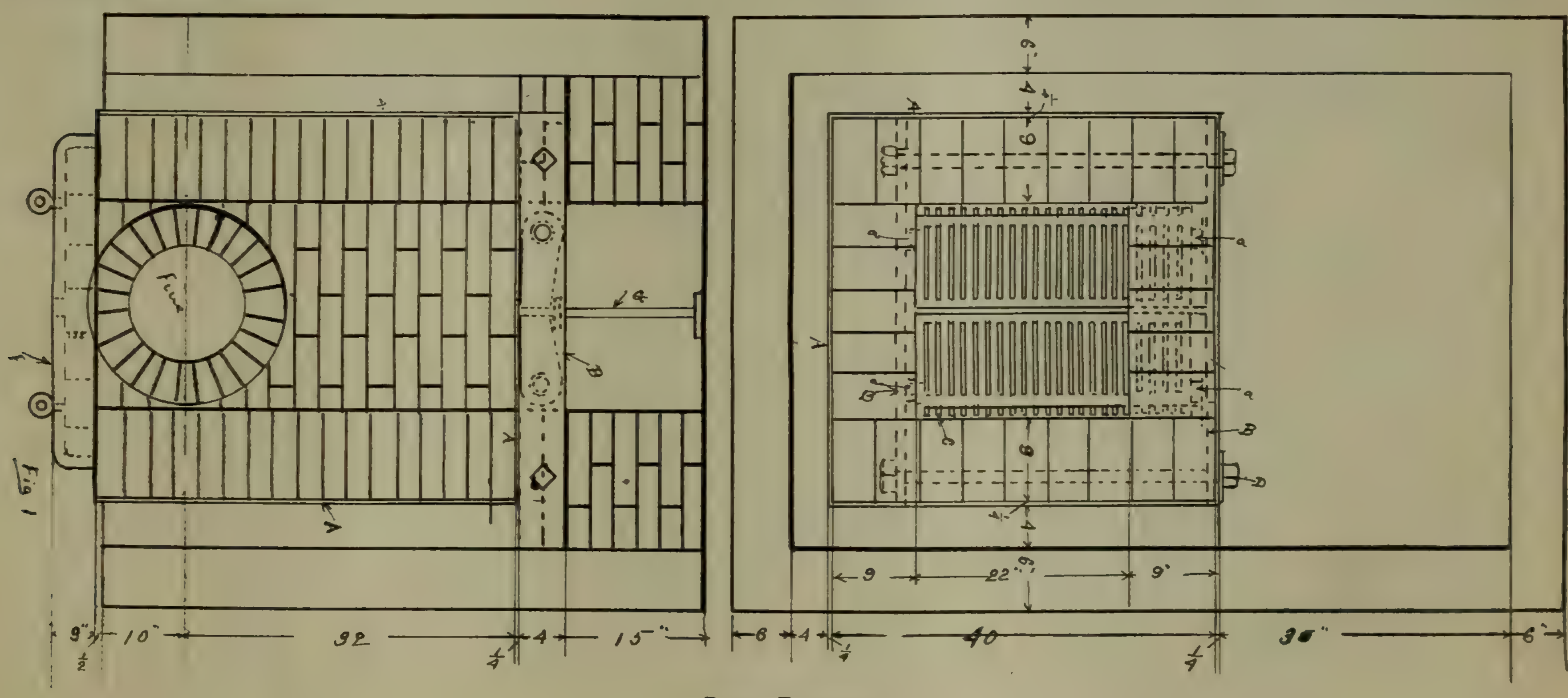
To begin the work of melting while molding was out of the question, for the heat arising from the fumes as the flames rose from the furnace soon made it unbearable for the operators. At the best one heat could be taken per day of eight hours and to get two heats required working far into the night. It was decided to put in a new furnace and the writer was commissioned to proceed with the construction, but the work was to be done in the ordinary course of work and not made a special job. I had had some experience with furnaces and decided a natural draft furnace with coke as a fuel would fulfill every requirement. A stack had already been made to be used for some other purpose but it was finally decided to use it for a coke furnace if such should be decided on. My first move was to get the casing for the furnace after I had decided on the size of the furnace. I got together with the boiler foreman and we secured some old quarter-inch plates of which was made the casing A. It was made deep enough to leave about four inches between the lower edge of the flue and the top of a 240-lb. crucible. The next move was to find some grates that would swing on trunnions or hinges as does the bottom of a foundry cupola. I found a pair of grates in the casting pile that just answered the purpose, as shown by Fig. 3 of the sketch. The lugs, as shown by dotted line, were broken off. The two bars 4"x1" were then cut and drilled and trunnion pins riveted on. For a cover we used an old valve chamber cover lined with fire brick.

After the excavation was made a concrete pit was put in with six-inch walls and concrete bottom, allowing sufficient depth for ash pit. The bars B were then placed on the top of the brick walls of the ash pit as shown in Fig. 1 with the three-quarter-inch rods in place. The casing A was then placed on top of these, leaving a space of about four inches between it and the walls of the pit. The casing A was then lined with fire brick as was also the flue. The inside dimensions of the furnace were 22 inches square by 42 inches deep.

The grates were put in place by removing front bar B and hanging onto pins A and then securing the bar by screwing on the nuts or rods D. The prop G was then placed in position and the grates held in place.

The pit was covered with an old flue sheet cut to size, the flue holes leaving ample opening for draft. A stack 16 inches in diameter 36 feet high was used on a base four feet high on the outside of the building, the flue passing out under the wall.

After the furnace was finished and placed in operation what had been a source of worry and trouble was changed to one of satisfaction. One man and his helper were able to turn out



Brass Furnace.

three heats per day in the hottest days of the summer time without more discomfort than the natural heat of the weather occasioned, and the economy in the fuel consumption was also marked. It was no longer necessary for the molder to suspend work while melting a charge of brass. As soon as the heat was drawn off he could immediately set up another floor while his helper was busy preparing the heat and continue his work while melting the charge.

Since this furnace was installed the foundry has been moved and enlarged and four such furnaces have been installed, one pair to a stack. It was at first suggested that it might be necessary to use forced draft but on trial it was found that the draft was all that could be wished.

To clean the grates requires very little time since they can be dropped and if necessary removed to clean out the air spaces when clogged by cinders or other obstructions and replaced very readily. To re-line the furnace does not require an expert, either. After all, the whole design is not new or original and my only excuse for offering this to the readers is to show how much can be accomplished with a very little, and how the efficiency of a plant can be increased by using just the things at hand, some of which have served their usefulness for the purpose for which they were originally intended and ordinarily would be consigned to the scrap heap. Then there is a satisfaction in the consciousness of having created something useful by using something that was soon to be discarded or had already been thrown away as no longer useful.

Much can be done in this direction if we but turn our attention to it more than we do, but it seems to be our nature more or less to disassociate old things with new and to think the new things require new material for their construction, and yet so much of what we use daily is made up of material that is old and has only changed its form.

PUMPS AND INJECTORS FOR FEEDING LOCOMOTIVE BOILERS.*

By A. Woolford.

The locomotive boiler is a very small one in comparison with its power of producing steam, and the quantity of water that has to be evaporated while the engine is working a heavy train is very large; consequently the problem of introducing the water to the boiler to replenish it by replacing that which has been withdrawn as steam is a very important one that is always present, or there is risk of the firebox crown being overheated very quickly.

In the large boilers that are now the vogue on most railways the difficulty of feeding them is relatively less than was the case with the very few small boilers that were the rule some few years ago, when the boilers were not only much smaller than they are now, but were also more out of proportion to their evaporation requirements.

Introducing cold, or even cool, water into a boiler, from which the hot steam is also at the same time being withdrawn, is likely to cause a fall in the temperature of the water in the boiler, and with it, necessarily, a reduction in the steam pressure, unless the firing and the introduction of the feed water are more or less skilfully carried out.

The water level in the boiler should be kept as nearly as possible to a uniform height when the engine is running, as great variations in the water levels are liable to impose temperature stresses upon the boiler. It is, however, well known that with heavy and fast trains it is sometimes very difficult to keep to this ideal, and it will be necessary in some extreme cases to shut off the water supply for short periods in order that the steam pressure may not be reduced too much, and then to fill up with water when the boiler has again recovered itself somewhat. This ''dodging'' of water into the boiler should not often be required with the large boiler now so usual. It is of the utmost importance that the instrument by means of which the water is forced into the boiler should be simple, easy to manipulate, and, at the same time, very reliable in operation.

In the early days of locomotive working the only way of introducing water into the boiler was by means of a pump, driven from some moving part of the engine. This seems at first sight an ideal way of keeping a steady water level in the boiler, as it is possible to set the water supply to the pump to the exact quantity that will replace that used as steam, so that the boiler is automatically fed. Unfortunately, the boiler would not always be able to produce steam when the calls upon it were very severe, and the feed would have to be shut off for a time; then, when the engine stopped, and with it the pump, there would be difficulties in filling up the boiler.

If the engine was a single-wheeled one, it was the custom to place it against buffer stops or scotches, grease the rails below the driving wheels, open the regulator, and let the engine slip on the rails until the boiler was full. If the engine was a coupled one, it had to be uncoupled from the train and run up and down on the rails to pump the water into the boiler.

One of two kinds of pumps was usually employed. A long-stroke pump, with a long plunger driven from the crosshead of the engine, or a short-stroke one, with a plunger of proportionately larger diameter, operated from one of the eccentrics of the link motion.

It is still the custom to use these kinds of pumps on those engines in which the exhaust steam is led into the water tanks to cool it down and prevent its emission in tunnels, as in these engines the water soon gets too hot for injectors to take it with certainty. It may not be out of place, however, to mention that pumps of this kind will not satisfactorily work very hot water, although they will take it of a higher temperature than ordinary injectors will. In some cases, when the water in the tank is too hot even for the pump to take it, it may be possible to get the pump to work if the tank lids are opened, so that air can freely enter the tank and thus save the situation.

It was, however, the limitations of the pumps driven from the engine itself, and their tendency to ''fly off'' when the engine jolted over point crossing, etc., in the rails, that led to their practical abandonment for ordinary use when a more satisfactory method of introducing feed water was invented in the injector. Pumps, but independent steam-driven ones, have been again introduced of late years to enable the great advantage of hot feed water to the boiler to be made use of, the best known being that made by Messrs. G. and J. Weir, of Glasgow.

The most usual method of introducing feed water to the locomotive boiler is by means of injectors, which are the most simple and compact instruments that have ever been devised for the purpose. They have the great advantage over pumps that practically all the heat in the steam used to operate them is returned to the boiler with the feed water. They can also be operated whether the engine is running or standing still, but have the disadvantage that they will not work with very hot water.

In the endeavor and hope of adding somewhat to the knowledge of the reasons for the injector's action, and for its limitations in working water into the boiler, a few notes on some of the more well-known makes are gathered together in this paper.

First, it may be mentioned that there are several different types in common use:

1. Ordinary fixed coned injectors, which may be intended to lift water, or to force it only.
2. Automatic restarting injectors, lifting or forcing.
3. Compound injectors or inspirators.
4. Hot-water injectors.
5. Exhaust-steam injectors, which may be worked by exhaust steam alone, or with the assistance of a jet of live steam.

The essential features of every injector are an outer case, which

*Paper read at the Institution of Locomotive Engineers (England).

contains three tapering tubes or cones, arranged in line, and concentrically with each other. The first cone has steam led into it, and it projects, more or less, into the mouth of the second or water cone, into which the cool water is allowed to enter, and in which the steam and water condense together; hence it is usually called the combining cone.

If the steam and water are allowed to meet each other at the proper temperatures and in a suitable way, an immediate amalgamation of the two will result by their condensing together in the combining cone, and a solid jet of water will issue from the small end of the cone and pass into the smaller end of the third or receiving cone, which is fixed with its small end facing the small end of the combining cone. A small space or gap is allowed between these two cones to enable any surplus steam or water to escape freely from the inside of the cones.

When the cones are in proper relationship to each other, and the amount of steam and water is correctly regulated, the resultant jet of hot water will travel at such a speed that it can meet and overcome the pressure within the boiler.

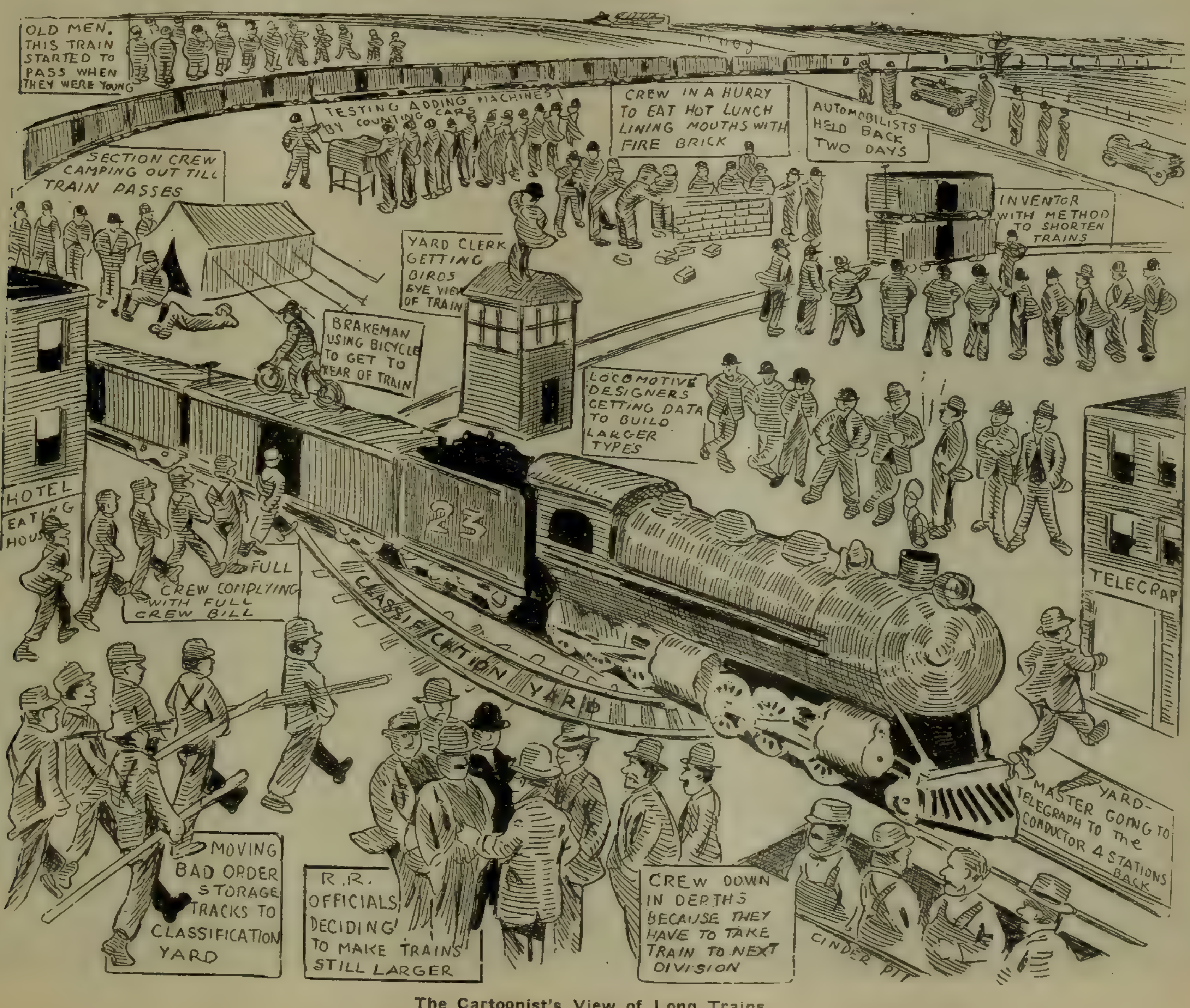
The curvatures and shapes of the cones are very important factors, and they will vary, theoretically, at any rate, with every variation in steam pressure and degree of temperature of the water fed to them. In practice it is not possible to vary the shapes at all, so all injectors made with fixed cones are made to be most suitable for a pressure about 10 to 20 lb. per sq. in. less than the maximum pressure they are required for, and then their range of good working in practice will be well within their limits.

In all injectors that are used with cold water it will be seen that the first or steam cone is largest in internal diameter, the combining cone next in size, and the receiving cone is usually smallest of all. At first sight this would appear wrong, but on examination of the operations that each is called on to perform, it will be realized that it is quite in accordance with natural laws.

Giffard's original injector was arranged vertically, and had adjustable steam and water cones—that is, they could be moved laterally in the body—and so the injector could be used either to lift or to force water at will by suitably moving the cones. There can be no doubt that this adjusting power, which allows of the same injector being used under various conditions, is one of the prime reasons why this form of injector has persisted so long in general use, as, owing to this power of adjustment, the capacity of the injector remains the same under very varying conditions of steam pressure and height of lift.

It is rarely that one is used on a locomotive nowadays, as the adjustment of the positions of the cones takes time and a certain amount of skill to carry out properly, and then, if the injector "flew off," both steam and water valves had to be shut off, and the whole operation had to be again gone through to start it working again, causing continual anxiety to the enginemen.

So far the simple injector has been considered, and, owing to its liability to fly off when any great variation in its supply of steam or water was made—as, for instance, the movement of the water in the boiler in stopping and starting the train, or the surging of the water in the tanks, especially when the water level



The Cartoonist's View of Long Trains.

in them had fallen low, or by the jolting of the engine running over points or crossings—some remedy was long sought after, and was found in the automatic restarting arrangement.

The action of all restarting injectors depends upon the automatic restoration of a state of affairs in the cones so that a vacuum can again be formed in the combining cone after a pressure there which has caused the injector to fly off has gone.

There are several ways in which this release of pressure can be carried out; three of the best known are the flap nozzle of Messrs. Davies and Metcalfe's injectors, in which the combining cone is split longitudinally, and part of it hinged at one end. When the injector is working properly and a vacuum is existing in the cone, the flap is held tightly closed by it, and the cone is, to all intents and purposes, a solid cone. The flap automatically opens the instant that a pressure is caused in the cone, and the pressure is released, the flap again closing the cone as the vacuum is again formed, when the injector once more starts to work.

The third measure is that of Messrs. Gresham and Craven's sliding cone. Here the combining cone is formed of two parts, and constructed so that the smaller end of the cone can move forward, and thus open a space between it and the fixed part of the cone, out of which pressure can escape, the movable part again closing when the vacuum is re-formed.

A need in some cases for an adjustable injector which can be easily modified to suit varying conditions of steam and water has led to the introduction of the one-movement injectors, in which the steam cone and combining cone are connected together by means of mechanism, so that by one movement of the starting handle the steam and water inlets are simultaneously opened to the suitable amount that the conditions may require. Such injectors may be either simple or automatic.

Injectors will deliver more water into a boiler with high steam pressure than with low pressure, but the amount of water delivered per pound of steam will be greatest with the lowest pressures; in other words, the injector is more efficient with lower than with higher steam pressures. The maximum delivery is obtained by reducing the amount of steam passed to the injector, and so increasing the vacuum in the combining cone, or by increasing the area of entry for water to this cone to compensate for the lower vacuum there.

INSTRUCTION CAR, GREAT EASTERN RAILWAY (ENG.)

More and more attention is being paid in England to instruction of enginemen and the happy-go-lucky methods of early years by which the man simply "picked up" his knowledge are being superseded by more scientific technical instruction. The Great Eastern Railway of England, which is now being managed by an American, H. W. Thornton, has recently put into operation an enginemen's instruction car.

The interior has been gutted and re-arranged as a school, exhibition and lecture theater. Benches with apparatus have been installed in one section while in another there is a stand and blackboard for the lecturer and seats for those attending. Working drawings are filed in an easily accessible manner, and altogether remarkably effective use has been made of the small available space. There is a complete set of Westinghouse brake fittings so arranged that the students can study them under actual working conditions. The vacuum brake is also represented by sectional ejectors of the ordinary and Dreadnought types, and among the other air-power apparatus there is water pick-up with its actuating valve, the air-sanding apparatus, and the air reversing gear complete. One side of these is taken away entirely so as to expose the interior locking gear and lifting nut.

A complete set of steam heating fittings is also exhibited for study and demonstration and the complicated action of the reducing valve is made very clear to the student. Furthermore, there is a sectional model of a superheater, there not being space for a complete superheater smoke tube and element. Mechanical lubrication is also made clear, although whereas the standard lubricator has eight feeds, the one shown in this inspection van has only two feeds. In one the pump is complete and in the other it is sectioned so as to show clearly the working. Great and special benefit is expected to be derived by the enginemen from the variable blast pipe fitted in the van. Owing to the comparatively recent standardization of the present pattern locomotive, drivers in this country do not seem to have fully comprehended its significance and possibilities. Many other pieces of apparatus are also shown with their working parts exposed. How the first part of the regulator operates, the reason for injectors choking up, way of preven-

Interior of Enginemen's Instruction Car, Great Eastern R. R. of England.

tion and remedy, are all made quite clear. The car will be sent gradually over the entire system. The few journeys it has gone so far have strongly emphasized the increasing interest shown by enginemen in this new device.

The illustration shows the interior of the car. On the right is the regulator, variable blast pipe, and air reversing gear; and on the left "Dreadnought" ejector, model valve motion, water pick up, etc.

BACK TALK.

Howard Elliott, the president of the New Haven Lines, said at a dinner in New York:

"I don't encourage back talk among our employes—far from it—but I must say my sympathies are rather with one of our conductors who ventured, under great provocation, on a little back talk, the other day.

"As the conductor was punching tickets, a man said to him, with a nasty sneer:

"'You have a lot of wrecks on this road, don't you?'

"'Oh, no,' said the conductor. 'You're the first I've seen for some time.'"

THE SITUATION IN BRIEF.

Returns for May reduced to a per mile of line basis and compared with the returns for May, 1913, show a decrease in total operating revenues per mile of 10.4 per cent., and a decrease in operating expenses per mile of 6.1 per cent. Net operating revenue per mile was less by $70, or 21.7 per cent than for May, 1913, while that for May, 1913, was 9.8 per cent greater than for May, 1912.

THE FOLLOWING TABLE is interesting as showing the roads which built locomotives at the company shops in 1913, together with the number built:

Canadian Pacific	81
Central of New Jersey	4
Chicago, Burlington & Quincy	10
Chicago, Milwaukee & St. Paul	55
Cumberland & Pennsylvania	2
Lehigh Valley	30
Pennsylvania Co. (all lines)	179
Philadelphia & Reading	12
Total	373

THE CHIEF INTERCHANGE Car Inspectors and Car Foremen's Association will hold its sixteenth annual convention at the Hotel Sinton, Cincinnati, O., on August 25, 26 and 27, 1914.

New Books

THE RAILWAY LIBRARY, 1913. Edited by Slason Thompson. Cloth, 6x9 inches, 469 pages. Published by Bureau of Railway News and Statistics, Railway Exchange Bldg., Chicago, Ill. Price, 50 cents.

The volume, which is published yearly, contains a collection of forty noteworthy addresses and papers of interest to railway men, most of which were delivered or published during the year 1913. Among the authors whose names appear are Theodore Roosevelt, Samuel Rea, J. T. Wallis, B. H. Meyer, Ralph Peters, Marcus A. Dow, Charles A. Prouty, Alba B. Johnson, Howard Elliott and Maj. Charles Hine. The articles cover a variety of subjects, including wages and the cost of living, cost of maintenance, railway rates, government ownership, management of foreign railways, workmen's compensation, railway mail pay, labor unions and railway valuation. Thirty-five pages at the rear of the book are devoted to statistics of American railways and a few statistics with regard to foreign roads.

Personals

J. L. ARMSTRONG succeeds the late W. J. Eddington as general foreman of the Corwith, Chicago shop of the *Atchison, Topeka & Santa Fe.*

E. P. GRAY succeeds B. A. Eldridge as general foreman of the *Atchison, Topeka & Santa Fe* at Arkansas City, Ark.

C. A. ZWEIBEL succeeds E. A. Sweeley as supervisor car repairs of the *Atlantic Coast Line* at Wilmington, N. C.

M. L. GRAY has been appointed general foreman of the *Atlantic Coast Line* at Charleston, S. C., succeeding G. L. Dibble.

P. C. LOUX succeeds G. H. Kaiser as road foreman of engines of the *Baltimore & Ohio* at Lorain, O.

W. W. BOULINEAU has been appointed master mechanic of the *Central of Georgia* at Cedartown, Ga., vice R. M. Boldridge.

F. D. BARNES succeeds W. W. Boulineau as road foreman of engines of the *Central of Georgia* at Macon, Ga.

RUDOLPH H. KAUPTZKY has been appointed master mechanic of the *Chicago, Milwaukee & St. Paul* and the *Des Moines Union*, with office at Des Moines, Ia. He succeeds A. Dallas, deceased.

P. SIMMONS succeeds W. J. Retallick as car foreman of the *Chicago, Milwaukee & St. Paul* at Miles City, Mont.

H. E. REYNOLDS has been appointed assistant air-brake instructor of the *Chicago, Rock Island & Pacific* in charge of instruction car 1,800, assigned to first district, headquarters Des Moines, Iowa.

R. C. EARLYWINE has been appointed assistant air-brake instructor of the *Chicago, Rock Island & Pacific* in charge of instruction car 1,801, assigned to second and third districts, headquarters El Reno, Okla.

J. A. OWEN succeeds A. S. Touhy as master mechanic of the *Colorado & Wyoming*, with office at Segundo, Colo.

H. P. MCCANN has been appointed mechanical engineer of the *El Paso & Southwestern*, with office at El Paso, Tex.

A. W. REDDERSON succeeds F. J. Stevens as superintendent of motive power of the *Fort Wayne & Northern Indiana Traction*, with office at Fort Wayne, Ind.

H. P. SMITH succeeds J. Hinds as master mechanic of the *Grand Junction & Grand River Valley*, with office at Grand Junction, Colo.

L. M. JACOBS succeeds J. W. Hackett as master mechanic of the *Houston Belt & Terminal*, with office at Houston, Tex.

F. C. FERRY has been appointed master mechanic of the *Louisville, Henderson & St. Louis*, vice J. B. Randall. His office is at Cloverport, Ky.

W. H. DAVIS succeeds C. E. Langton as master mechanic of the *Marshall & East Texas*, with office at Marshall, Tex.

N. W. MARTIN succeeds A. M. Dustin as foreman boiler shop of the *Minneapolis & St. Louis*, with office at Minneapolis, Minn.

H. J. HURLEY succeeds O. J. Burton as roundhouse foreman of the *Minneapolis & St. Louis* at Ft. Dodge, Ia.

R. S. MENEFEE, roundhouse foreman of the *Minneapolis & St. Louis*, has been transferred from Morton, Minn., to Des Moines, Ia., succeeding H. J. Hurley.

A. J. GEARHEILY succeeds R. S. Menefee as roundhouse foreman of the *Minneapolis & St. Louis* at Morton, Minn.

C. H. QUINN has been appointed chief electrical engineer of the *Norfolk & Western*, with office at Roanoke, Va. Mr. Quinn was formerly assistant engineer of motive power.

J. W. BLACKBURN succeeds P. H. Cosgrove as general car foreman of the *Oregon Short Line*, with office at Salt Lake City, Utah.

L. H. THACKER has been appointed foreman car repairs of the *San Benito & Rio Grande Valley*, succeeding T. A. Martin. His office is at San Benito, Tex.

GEORGE SEARLE succeeds W. A. Rogers as master mechanic of the *San Pedro, Los Angeles & Salt Lake.* His office is at Las Vegas, Nev.

E. A. SWEELEY has been appointed master car builder of the *Seaboard Air Line,* with office at Portsmouth, Va. Mr. Sweeley recently resigned as supervisor car repairs of the Atlantic Coast Line.

PAUL JONES has been promoted to assistant master mechanic of the *Southern Pacific* at Sparks, Nev.

OBITUARY.

D. J. MALONE, superintendent of the Pocatello, Ida., shops of the *Oregon Short Line,* was shot and killed on July 24 by Frank Madden, tin shop foreman. Madden then killed himself.

Among The Manufacturers

LOCOMOTIVE FRAME PLANER.

The accompanying illustration shows a 96″x84″ locomotive frame planer recently built by the Niles-Bement-Pond Company. It is especially designed for planing locomotive frames in the shortest possible time. The machine is driven by a 75 H. P. reversing motor and is equipped with electric feed, rapid power traverse for heads, variable speed controller and pendant switch.

The motor is directly connected to the first driving gear shaft on the back side of the planer, giving the operator free access to the entire control at the front of the machine.

There is provided a wide range of cutting and return speed, which may be varied independently of each other, while the machine is running, by means of the two handwheels on the front of the controller case. The handwheels are equipped with dials graduated for the various speeds.

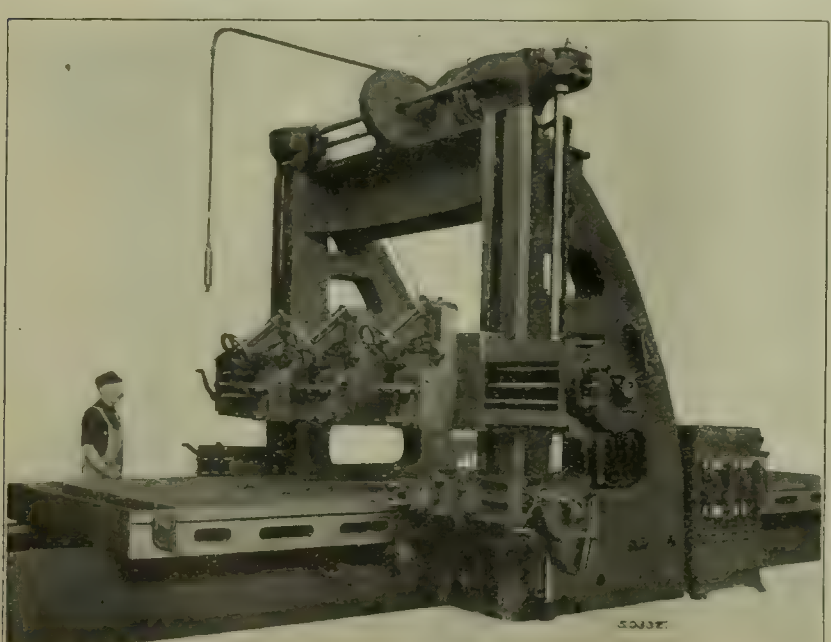
A shaft runs through the bed with levers on either side for hand control of the table. These levers are the same as on a belt driven planer; hence the operator has no new movements or operations to learn.

A patented pendant switch, carried by a swiveling bracket mounted on the arch, may be moved to any convenient position. By means of this switch the operator can start, stop or reverse the table if the work requires him to be in such position that he cannot readily reach either of the levers on the front and back sides of the bed.

At the instant of reversal, the motor, through connections in the controller, is disconnected from the line and becomes a powerful dynamic brake, stopping the table at once without drawing any current from the line.

To prevent the table from running off the bed and also the breakage of tools or planer, a patented circuit breaker is provided which will stop the motor at once by dynamic breaking.

The newest and most novel feature of this planer is the electric feed and rapid power traverse which is provided for all heads. Both the feed and traverse are operated by a separate motor mounted on the arch. This motor is also used for elevating and lowering the cross rail. The mechanism for the different operations is interlocked in such a way as to prevent accidental engagement of two functions simultaneously.



96″x84″ Locomotive Frame Planer.

The amount and direction of the feeds for the cross rail heads can be changed at each end of the rail. The changes of feed for the side heads are made in a similar manner, the feeds for each head being entirely independent of each other and of the cross rail heads.

The hand adjustment of the side heads is by ratchet crank wrench which is mounted on and moves with the head. All heads have graduated swivels and micrometers on the feed screws.

The table is of heavy and very deep box section, without openings through the bottom wall. This gives a very rigid construction and also prevents chips or cutting fluid from reaching the gears or tracks in the bed.

Three heads are provided on the cross rail and one side head on each upright. The cross rail heads have handwheels operating through bevel gearing for convenient adjustment of tool slides.

BOILER MAINTENANCE AND WATER TREATMENT.

One of the perplexing problems which the mechanical departments of all railways have to contend with to a greater or lesser extent, is the cost in the upkeep of their locomotives, mainly on account of the heavy formation of scales, and corrosion and pitting on the crown-sheets and tubes of the boilers, caused by acids and impurities in the water.

There are many compounds on the market, which, it is claimed by the manufacturers, will dispose of the scale by dissolution, and they are extensively used but with varied results. Millions of dollars have been spent in purifier plants by a number of the railways, also with varied results.

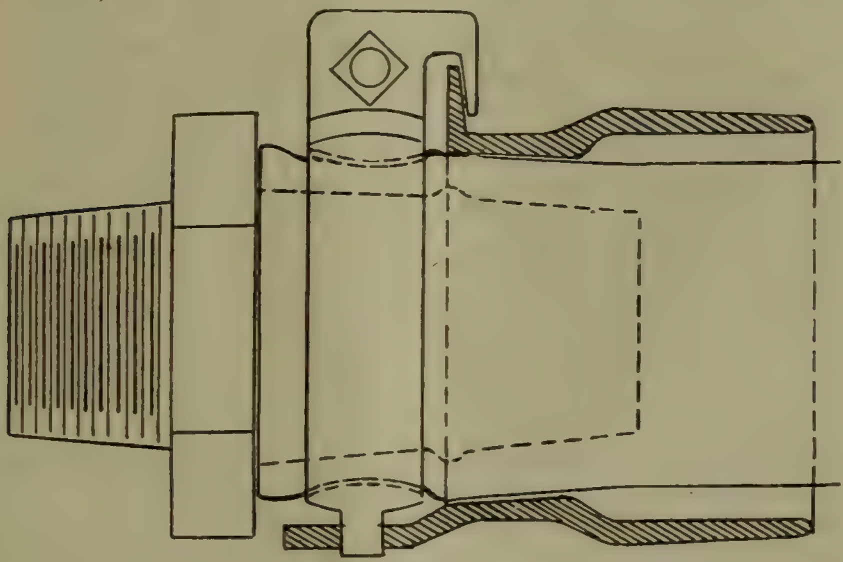
A new method of treatment has been put into effect on a number of roads with marked success. The material used is called, by the manufacturers, The Bird-Archer Co., 90 West street, New York, "Polarized." It is a composition of many ingredients adapted to individual needs, but in each case is based upon metallic mercury. By its use it is said that the periods between boiler washouts have been increased in some instances by 500 per cent.

It is put up in sticks, seventeen inches in length and one inch in diameter. Each stick weighs about one pound, and in appearance resembles fire brick. Several sticks are placed in the washout holes over the crown sheet and tubes after each washout. The mercury is divided into very small particles, and as the sticks dissolve, the mercury is carried by circulation to all parts of the boiler. The polarized mercury naturally seeks the metal, and where there is a ragged edge of scale, it works its way under the scale and the heat from the metal causes it to expand, thus throwing off the scale. The mercury, with other ingredients, then forms a black metallic oxide coating over the crown sheet and tubes protecting them from acidity and galvanic action.

It will be appreciated that treatment by this method makes it one not in any way dependent upon engine crews. It is applied only when the boilers are open for washouts at terminals and in the shops. This fact eliminates many difficulties which have arisen in the past and makes it easy to give the boilers accurately the treatment they may need.

PEFFER'S HOSE PROTECTOR.

A great number of the air brake hose failures are caused by damage to the hose at its connection with the nipple, and the Peffer's air brake hose protector is designed to protect the hose at this point. The device is shown in the accompanying illustration. It is a one-piece malleable shell, closely surrounding the hose at one end and being enlarged at the other



Peffer's Hose Protection.

end. In case of a heavy blow being struck the hose this device takes up the force of the blow and the bell shaped end allows the hose to bend considerably without chafing against the sides.

The clamping device is made separate from the protector so that if it should be broken by strain the protector may be saved for further use. The protector is said to be practically indestructible and can be applied at a very low cost. It is being placed on the market by the Railway Economy Device Co., 1303 Chamber of Commerce, Chicago.

STEEL FREIGHT CAR PATENT.

On June 19, 1914, the United States patent office issued to William R. McKeen of Omaha, Nebraska, "Patent No. 352,725, All Steel Box Car," which is a patent of unusual importance. It has been in litigation since 1906. Having passed two hotly contested interference cases—argued before the highest of patent experts: Examiner in Chief, Commissioner of Patents and the Court of Appeals of the District of Columbia—practically every claim made by Mr. McKeen for new and novel features of the All Steel Box Car subject matter has been awarded to him and this substantiates the validity of the patent beyond question of doubt.

Union Pacific cars No. 72,850 and No. 72,851, built in 1906 and 1907 under this patent, were the first two all steel box cars built, and they have made a remarkable record for efficiency and freedom from accident as well as for carrying successfully all kinds of materials in all kinds of climates. As with seagoing vessels today, a wooden vessel is almost a novelty, so will in a very limited number of years, a wooden car be something unusual and novel to see.

The scarcity of lumber, the difficulty of obtaining large quantities of lumber necessary in the construction of box cars, has almost necessitated and forced the entire use of steel in freight equipment. Then too, account of larger engines, the growth of business, larger carrying capacity and the greater strength required, steel in box car construction is, philosophically, the only means of meeting the present day conditions and requirements.

The continual increase in the size of the wooden members of ordinary car construction had practically reached its limit some years ago and yet the size of the car continued to increase.

When the first two light weight all steel box cars were turned out of the Union Pacific shops at Omaha many authorities among railway men thought there would be considerable trouble in transporting hydroscopic and other similar materials, particularly so in hot climates; others thought the transportation of grain would be impossible. It seems, however, that practically all of the steel box cars on the Pacific Coast, in the arid and semi-arid regions of the West and torrid regions of the South, have handled all kinds of material equally as well, and in many instances in a manner superior to that of the wooden cars and with less claims for freight damage en route over that of the wooden car. For loose grain one can readily understand that a steel car is almost ideal, as a wooden car develops cracks and crevices which are extremely difficult to prevent from leaking, especially so in old cars.

Patent No. 352,725 covers not only the steel underframing but covers the steel superstructure, the steel box, the steel bracing on the box, the diagonal bracing, and in fact covers all the features of steel box car construction.

WIPING CLOTHS.

The use of wiping cloths in shops has become more popular of late, due to the fact that they possess a number of advantages over cotton waste as various sized rags can be used for different purposes such as wiping glass, woodwork and fine machinery. A high grade of wiping cloths is being supplied to railway trade by L. J. Cohen &, Co., 23 Branch St., St. Louis, Mo., and they have not only proven satisfactory but have shown a considerable saving over cotton waste. These wiping cloths are composed of soft cotton material such as aprons, petticoats and wrappers, which have been thoroughly washed and sterilized, and have had all buttons, buckles and metal parts removed. It is said that while these cloths are one-half the price of cotton waste, they will go much further for all wiping purposes as they readily absorb oil, paints and water. For polishing they are exceptionally valuable as they leave no lint.

New Literature

The Gold Car Heating & Lighting Co., New York, has just issued a circular descriptive of its latest type of steam hose coupler, No. 804S.

* * *

The National Malleable Castings Co., Cleveland, O., in circular No. 67, gives a description and illustration of its malleable iron coal picks for locomotive tenders.

* * *

"National" forging machine talk No. 4, issued by the National Machine Co., Tiffin, O., has for its subject, "How big die opening effects economy in the forging machine."

* * *

A very attractive folder on Mudge-Peerless car ventilators for steam railways has been issued by Mudge & Co., Chicago. It contains an interesting chart showing the air discharged by the ventilator at various rates of speed.

The Selling Side

Harry C. Hollaway, who has represented The Rail Joint Co. for several years, has resigned and has opened an office at 647 Railway Exchange building, Chicago. He will handle railway supply accounts.

G. K. MacEdward, advertising manager of the Detroit Lubricator Co., has resigned to go with the Chalmers Motor Co.

The American Mason Safety Tread Co. has just received an order for over eighty tons of its "Karbolith" sanitary fireproof car flooring for the new steel cars of the Southern, which are being built by the Pressed Steel Car Co.

The Milwaukee Locomotive Mfg. Co., Milwaukee, Wis., has increased its capital stock from $50,000 to $250,000 and is completing important additions and planning to extend its operations.

MUDGE & Co.. of Chicago, who have for a period of several years been authorities on passenger car ventilation, are now manufacturing and selling their own ventilator, which is known by the trade name—Mudge-Peerless.

STEPHEN C. MASON, secretary of the McConway & Torley Company, has been appointed an executive member of the Railway Business Association.

JOHN C. NEALE, assistant general manager of sales of the Carnegie Steel Company, has resigned to become president of the Central Steel Company, Massillon, Ohio. JOHN W. DIX has been appointed assistant general manager of sales and structural engineer of the Carnegie Steel Company, succeeding John C. Neale. His office is at Pittsburgh, Pa.

THE MIDDLETOWN CAR COMPANY, Middletown, Pa., has enlarged its plant at a cost of $500,000.

THE INDEPENDENT PNEUMATIC TOOL COMPANY has leased the two-story building at 334 St. James street, Montreal, Quebec, and has arranged to open a branch store, where Canadian business will be transacted. W. H. Rosevear, who has been prominent for years in the railway supply and machine tool business in Canada, has been engaged as manager.

RALPH W. PERRY, chemist and engineer of tests for the Michigan Central, has severed his connection with the Michigan Central and has established the Perry Testing Laboratory, for conducting a general chemical, inspecting and testing business.

THE UNITED STATES LIGHT & HEATING COMPANY, Niagara Falls, N. Y., went into the hands of a receiver on July 13. Two actions alleging fraud and mismanagement were filed against the company. The following have been appointed as receivers: A. Henry Ackermann, Niagara Falls, vice-president of the company; Guy M. Walker, of New York, and James O. Moore, of Buffalo.

GEORGE H. HANSEL has organized the Railroad Valuation Company, with offices 25 Broad street, New York. Associated with this company are engineers, analysts and accountants of wide experience well known as experts in valuation work.

C. W. CROSS has been appointed Chicago representative of the Equipment Improvement Company, of 30 Church street, New York. Mr. Cross started railway work with the Pennsylvania and left the position of assistant master mechanic at Fort Wayne to become master mechanic of the Lake Shore & Michigan Southern, at Elkhart, Ind. He was made superintendent of apprentices of the New York Central Lines in 1906 which position he now resigns.

W. D. JENKINS has been appointed southern representative of the Union Railway Equipment Company, Chicago, with office in the Whitney Central building, New Orleans, La.

COLONEL H. G. PROUT has resigned as president of the Union Switch & Signal Company and W. D. Uptegraff, formerly vice-president, has been appointed president pro tempore.

SYDNEY G. JOHNSON vice-president of the Union Switch & Signal Co. has resigned.

T. W. SIEMON has been elected secretary-treasurer of the Union Switch & Signal Co., succeeding J. H. Johnson, resigned. Mr. Siemon was formerly treasurer of the Westinghouse Electric & Mfg. Co.

THE PENNSYLVANIA EQUIPMENT COMPANY, Philadelphia, Pa., has moved its office from the West End Trust building to 503 Coleman building.

THE PRIME MFG. COMPANY, Milwaukee, Wis., has been organized to manufacture and market railroad supplies. The company is capitalized at $2500, with A. W. Prime and H. G. Wild as incorporators.

JOSEPH T. RYERSON & SON, of Chicago, have established warehouses in St. Louis for immediate service of steel to customers in the St. Louis territory. In doing this they have taken over the W. G. Hagar Iron Co. and have added to this plant modern warehouses and equipment.

ALBA B. JOHNSON, president of the Baldwin Locomotive Works, has been elected a director of the class B group for the new federal reserve bank in the Philadelphia district.

JOHN B. ALLAN, who until recently was vice-president and general manager of the Allis-Chalmers Co., died July 28 at Oak Park, Ill.

CHARLES R. CRANE will retire shortly as president of the Crane Company, Chicago, and will be succeeded by R. T. Crane, Jr., now first vice-president. R. T. Crane, 3rd, will be advanced from second vice-president to first vice-president.

SIDNEY G. JOHNSON has been appointed assistant to the president of the General Railway Signal Co., Rochester, N. Y., and will have his headquarters at 55 Liberty St., New York. Mr. Johnson recently resigned.

W. H. CADWALLADER, assistant to the general manager of the Union Switch & Signal Co., has been appointed general manager.

THE AMERICAN FLEXIBLE BOLT CO., Pittsburgh, Pa., has opened offices at 50 Church St., New York, with R. W. Benson, general manager, in charge.

THE RAILWAY & TRACTION SUPPLY CO. has moved its office from 1307 to 504, Rector Building, Chicago.

In the United States District Court in Buffalo on July 21, Judge Hazel appointed James O. Moore and James A. Roberts receivers for the U. S. Light & Heating Co., following a case in equity. That it was a case in equity and not in bankruptcy was made evident in the hearing. It was clearly outlined by the Court that there should be no interruption in the fulfillment of existing contracts, in the prosecution of pending business or in the company's operations in any department.

A. H. Ackermann, vice-president and general manager prior to the receivership, was immediately appointed general manager to operate the business because of his familiarity with it, and the entire staff of salesmen, engineers, etc., were retained in their former capacities. Mr. Ackermann has issued the following statement to the trade and to the public: "The action recently sustained in the appointment of the receivers for the property of the company was a necessary step to conserve the assets for the benefit of all. With assets of three dollars for every dollar of debt, the company is amply stable, and the Court's direction to continue the business is the last proof necessary to reassure the buying public. There are already under way plans for broad financing, U. S. L., more aggressive than ever before, intends to secure its and with the return of general prosperity in the country the own full share of the business and to continue the manufacture and sale of its special electrical products."

RAILWAY CONSTRUCTION.

The Atlantic, Gulf & Pacific Co., New York, and MacArthur Bros. Co., New York, have started work on terminals at Charleston, S. C., for a subsidiary of the Carolina, Clinchfield & Ohio.

The Atchison, Topeka & Santa Fe has authorized improvements to cost $350,000 for its Los Angeles division. The work includes bridge installation, passing tracks and bank protection work.

The Alton & Jacksonville, an electric line, has been incorporated to build a line between Jacksonville and Alton, Ill.

The Baltimore & Ohio will start extension work soon on eliminating curves and cutting down grades on Ohio River division. Work will be commenced near Sistersville, W. Va.

The Birmingham & Southeastern will extend its road at an early date from Eclectic, Ala., to connect with trains entering Birmingham and Anniston.

The Canadian Northern has opened bids for completion of several branch lines in Manitoba, Alberta and Saskatchewan. This road has surveys under way for extension of the Radville branch toward Weyburn, Sask. Grading contracts will be let this fall.

The Chicago & Lake Superior is considering extending its line to Rockdale and Edgerton, Wis.

The Chicago & North-Western has let a contract to Teppard & Burrill, Minneapolis, Minn., for the construction of a branch line from Koepenick, Wis., eastwardly to the west bank of the Wolf river.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S. MYERS, Vice-Pres. — L. F. WILSON, V. P. & Editorial Director
C. C. ZIMMERMAN, Bus. Mgr. — OWEN W. MIDDLETON, Editor
DALTON RISLEY, West. Mgr. — W. A. D. SHORT, Editor

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: House Bldg., Pittsburgh, Pa.
Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.
This Publication has a larger circulation than any other among mechanical department officers. Of this issue 5,000 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, September, 1914 No. 9

CONTENTS

Master Blacksmith's Convention

The master blacksmiths held their twenty-second annual convention at Milwaukee last month and some very interesting material was presented, as may be seen in the report of the meeting published on another page. A large amount of material in the shape of blueprints, photographs, etc., was brought to the meetings and it is to be regretted that this matter in its entirety could not be presented to a larger number of blacksmith foremen. The association has a membership of about 300 and had a goodly proportion of live members in attendance, but with the large number of blacksmith foremen in the railway shops of this country, it would appear that a campaign for additional members would benefit both the association and the new members.

It was proposed at the meetings that the papers be printed in advance next year, and this idea should be carried out if at all possible. This not only benefits the members attending, but should also help in getting new members, for by sending prospective members copies of papers in advance of the convention, their interest would be aroused and they could more easily be induced to join. The benefit to the attending member is very evident, for he has the opportunity to study the paper and can therefore discuss it to better advantage. The cost is but very little more for the illustrations, and the type can be used again in the published proceedings. The difficulty of getting committee reports and papers in early enough will of course be encountered, but this can be overcome. It is just as easy for a man to get his report in in nine months as in twelve, if he knows it has to be in. There are other associations which might very profitably publish advance copies of their papers also.

Locomotive Cylinder Lubrication

The cylinders and valves of locomotives have received their lubrication in a more or less haphazard way since the operation of the first engine was made possible by doping with tallow at intervals of convenience to the fireman. The groaning of pistons and flat valves was the indication of need of lubrication—and the only one; and the tallow pot furnished the only means of reducing cylinder and valve friction for a good many years in the history of locomotive operation.

Just as the use of tallow was unsystematic and the frequency of application not based on any certain amount of piston travel, the modern hydrostatic lubricator, riding in the cab and delivering its drops of oil at fixed time intervals, does not perform completely its function of lubricating in relation to the varying demand, except as inefficiently gauged by the hand and eyesight of the engineman. It has proved a very great improvement in the means for lubrication and it has reached a high plane of efficiency so far as it is possible for efficiency to be obtained by this principle.

It was the change from saturated to superheated steam, however, which directed particular attention to the problem of lubrication. There was more anticipation than realization in lubrication troubles chargeable to the change, but there was, nevertheless, necessity for greater care in avoiding undue friction with the higher temperatures.

Those familiar with the problem of lubrication have taken note of the inconsistency of graduating the injection of the lubricant by time interval, and several attempts have been made to lubricate

according to piston movement or, in other words, to supply lubricant when needed and only when needed, as well as in quantities not to exceed the actual demand. Graphite lubricators which operate from the valve motion have been invented and applied, but graphite, although a most excellent lubricant, has been found to be a source of trouble when fed in this way, on account of the alleged fact that it accumulates in embarrassing places, such as in the recesses under the piston rings. Experience thus far seems to indicate that this method of lubrication cannot supersede oil in any event, and therefore it follows that the problem of distribution of oil remains.

The use of force feed oil distributers, which obtain their motive power from some moving part of the locomotive, have been found to function smoothly. One system of force feed lubrication is quite generally in use on certain roads, indicating satisfaction; while it has not been tried at all on others. All must admit that the force feed system is correct in principle. There remains room for difference of opinion as to the intrinsic merits of the machines used. Proper conclusion as to these merits can only be secured by test, and tests should be made, except where the word of another mechanical officer who has made them may be taken.

If pistons did not move they would not need lubrication. Therefore they should receive lubrication only when they do move.

Rule 120

At the recent convention of the Chief Interchange Car Inspectors' and Car Foremen's Association considerable discussion took place on rule 120 of the Master Car Builders' Rules of Interchange. This rule was recently changed, it will be remembered, eliminating the home routing of cars unsafe to load on account of a general worn-out condition. According to the rule as it now stands, the owner has two options; he can authorize the handling company to rebuild the car or he can authorize the handling company to destroy it. However, there is no time limit within which the owner must exercise his option, and around this fact considerable discussion centered.

A number of the members gave it as their experience that it was often a matter of months before they could get action on cases. Although it is true that according to the Code of per Diem Rules per diem ceases from the day the report of the car's condition is made by the handling company, some roads evidently find it advantageous to allow the car to remain on a foreign line for months before giving a decision as to the disposition of the car. This often works a hardship on the handling line, whose sidings become filled with cars which are waiting for advice from the owner. The privilege of destroying the car if no reply was received within 30 or 60 days was advocated by some as a remedy for the above mentioned condition. It is possible that this might better conditions, but what is primarily needed is closer co-operation on matters of this sort and less of a disposition to "pass the buck" to someone else.

Angus Tool Room

A prominent feature of the Angus shop tool room of the Canadian Pacific is its organization for handling the various kinds of work which fall to it. As stated in an article on another page, the organization is divided into three departments, each in charge of a capable assistant. One has charge of milling cutters, taps, dies and other regular tool room work; one has charge of repairing machine tools and building special machines, and one has charge of forging, tempering and grinding lathe and planer tools and inspecting emery wheels.

Such an organization allows the tool room department the opportunity to work to the best advantage, especially in a large plant, as it places under one head the keeping of the shop in the best of shape to handle its work from day to day. The placing of three different phases of the work under as many assistants is an admirable one. A commendable feature is that upon one of these assistants devolves the care of all emery wheels in the shops.

Other noticeable features, as set forth in the article referred to, are that the tool room has at present about ninety sets of inserted blade cutters, of from two to six cutters per set, and that all gauges are sent to the tool room once a month for checking, a record of the condition of each gauge being kept by the foreman. A reading of the article, together with a study of the illustrations, indicates that the tool room at the Angus shops has been put upon the proper basis and that its work is of the highest character.

Who Caused the Wreck?

The *Railway Master Mechanic* is not a short-story magazine. Fiction is, generally speaking, barred from its columns. The story published on another page of this issue under the title "Who Caused the Wreck" is so pointed in its moral and so aptly illustrates a condition which all thinking railway officers deprecate, that deviation from the fixed policy seems advisable and we recommend that every mechanical officer read it.

FIRE FIGHTING ON THE B. & O.

By virtue of a circular issued by the Baltimore & Ohio to its employees, the men working for that company are to be constituted into a vast organization of fire fighters, ready for emergency service in protecting the property of the public and that of the railroad against destruction by fire.

Employees in train service and others whose duties require them to travel over the property are urged by the management to maintain a constant vigil against fire, either on the property of the railroad's neighbors or along its own right of way. Suggestions concerning precautions against fires are requested of the employees.

In the event that fires be discovered by engineers, conductors or other employees in train service, they are peremptorily authorized by the company to lend assistance in extinguishing the blaze; but the regulation requires that in such emergency any delay occasioned by assisting in putting out a fire must be reported at the first telegraph station.

While the regulation concerning the suppression of fires has in view primarily the protection of railroad property, the Baltimore & Ohio urges its men to take a broad interest in the communities in which they reside, so that at all times they may render assistance of direct benefit to society. In the cities and towns, division points and terminals, the railroad has provided fire-fighting apparatus for the use of employees in emergency cases; and to increase the efficiency of such protection the men are drilled in order that they keep themselves on the alert. Numerous instances have been reported of railroading forces preventing serious fire destruction.

The campaign waged by the Baltimore & Ohio against fire losses extends beyond the employees to the mechanical operations of the property. Locomotive stacks have been equipped with spark nettings to prevent particles of fire from being scattered along the right of way or on adjoining property, and the fire grates in the engines are so designed that hot coals are not dropped along the tracks.

Twenty Years Ago This Month

(*From the Files.*)

J. H. Barry has resigned as master mechanic of the Cincinnati & Sandusky division of the Cleveland, Cincinnati, Chicago & St. Louis.

J. T. Chamberlain, master car builder of the Boston & Maine, has removed his headquarters from Lawrence, Mass., to Boston.

Albert Griggs has been appointed assistant superintendent of motive power of the Chicago & Eastern Illinois, with headquarters at Danville, Ill.

James A. Keegan has been appointed master mechanic of the Cincinnati & Sandusky division of the C. C. C. & St. L., with headquarters at Delaware, Ohio.

A. M. Land, chief car inspector and foreman of shops of the Nashville, Chattanooga & St. Louis, at Atlanta, Ga., has been appointed master mechanic of the Southern Ware Car Line, with headquarters at Atlanta.

R. D. Wade, superintendent of motive power of the eastern system of the Southern railway, has had his jurisdiction extended to include the western system. He will be assisted by an assistant superintendent motive power with office at Washington, D. C. Mr. W. H. Thomas, the former superintendent motive power of the E. T. Va. & Ga., has, since the formation of the new company, held the position of superintendent motive power of the western system.

The second annual convention of the National Blacksmiths' Association convened on Tuesday, the 4th inst., at Allegheny City, Pa.

L. H. Sherman has resigned as master mechanic of the Mexican National at Santiago, Mex.

F. G. Lauer, foreman locomotive repairs of the Buffalo, Rochester & Pittsburgh, at Rochester, N. Y., has been appointed master mechanic of the road at that place.

E. W. Knapp, locomotive foreman of the Mexican National, at Monterey, Mex., has been appointed master mechanic of that road at Acambaro, Mex.

W. H. Thomas, formerly superintendent motive power of the East Tennessee, Virginia & Georgia, has been appointed assistant superintendent motive power of the Southern railway, with jurisdiction over both the eastern and western systems. Headquarters, Washington, D. C.

Col. Adaee F. Walker, the new receiver of the Atchison, Topeka and Santa Fe, arrived in New York from Antwerp on September 3, and immediately assumed his duties as receiver of the Sauta Fe. He proposes to remain in New York for some time, familiarizing himself with the present condition of the property. Then he will go over the railroad with the other receivers and the principal officers of the company, and after completing the inspection of the property he will probably make his headquarters in New York.

Howard F. Parke, formerly division superintendent of the Missouri Pacific at Sedalia, Mo., has been appointed superintendent of transportation for the Union Pacific, Denver & Gulf Road, with headquarters in Denver.

John E. Searles, of Baltimore, Md., has been elected president of the Baltimore, Chesapeake & Atlantic, a new company organized to develop the railway and steamship systems of the Maryland Peninsula.

George C. Smith, formerly assistant general manager of the Missouri Pacific, has been appointed president and general manager of the Western Ry. of Alabama.

C. E. Schaff has been appointed assistant general manager of the Cleveland, Cincinnati, Chicago & St. Louis.

THE PENNSYLVANIA RAILROAD announced in 1906 that all future additions to its passenger equipment—passenger coaches, postal cars, baggage cars, express cars, etc.—would be of all-steel construction, and on January 1, 1914, almost exactly one-half of its passenger equipment had been replaced with steel cars. The Pennsylvania had 6,100 passenger equipment cars in service on January 1, 1914.

CORRESPONDENCE.

Editor, *Railway Master Mechanic:*

Referring to the article in your issue for August, page 368, on "Valve Gear Device," by B. N. Lewis, I quote from the third paragraph as follows: "The heavy constant lead (Walschaert gear) required at short cut-offs, in order to maintain sufficient port opening, where little opening other than that transemitted by the combination lever is given to the valve, causes too early a preadmission of steam at maximum cut-off and decreases the starting power of an engine so equipped."

The device described by Mr. Lewis will, no doubt, remedy the above trouble, yet equivalent results may be obtained by proper valve proportions. The port opening required at working cut-off may be attained by giving the valves the required lead, and in order to reduce and render preadmission negligible so far as starting is concerned, lap should be added.

I have found engines with $\frac{3}{16}$-in. lead, 1-in. lap, $\frac{1}{8}$-in. preadmission in full gear, and $\frac{5}{16}$-in. port at 33 per cent cut-off. These engines did not develop full tractive effort, due to insufficient port. They were given $\frac{3}{8}$-in. lead and $1\frac{1}{4}$-in. lap, the preadmission remained $\frac{1}{8}$-in. in full gear. Indicator diagrams gave entirely satisfactory results and no difficulty was experienced in starting on heavy grades.

My experience has been that any required port may be had by giving sufficient lead and making the lap such that no more than $\frac{1}{8}$-in. preadmission is obtained in full gear. A valve diagram should be laid out from which the proportions of the valve may be determined.

Special care should be exercised in dividing the lead and seeing that the reach rod adjustment is such that the proper valve travel is obtained in full gear.

GEORGE W. BASHAW, Chf. Draftsman,
D. & R. G. R. R., Denver, Colo.

ALL-STEEL CARS are being experimented with on several railway lines in India. Other lines probably will undertake experiments or await the results of the experiments of lines that now have the matter under consideration.

Metal freight cars have long been in use in India, but passenger cars are usually built of teakwood resting on steel underframes. Owing to the intense heat, and in some cases the great changes in temperature through which cars pass, the wood warps, swells or shrinks, and joints are affected. This causes a certain swaying of the body and throws doors and windows out of plumb, causing more or less jambing. The element of danger to life is also being considered.

DECISION.

To say that decision of character is a valuable asset in life is to utter a truism. The fact is obvious. Indecision is indeed a form of procrastination, which is a thief of time. The indecisive man is losing time at every turn, he is always thinking what he had better do when he ought to be doing it, and his coefficient of efficiency varies directly with the amount of decision he can muster. And the quality is the more valuable at the present time, inasmuch as it is losing ground. The more highly civilized we are, the greater the tendency to indecision. The animals are decisive enough; as soon as the idea is in their heads they act on it, and do not trouble themselves to reflect whether they might not have done something better. The primitive man is also decisive. It is the man with the cultural habit of mind who is everlastingly doubting, examining and re-examining, questioning, stating his case and asking advice, and refusing to conclude. He not only wastes time, but he often makes himself very unhappy, and in the affairs of this world he is at a disadvantage with the man who uses all his steam for forging straight ahead. Yet, though in his heart of hearts he envies those who are never afflicted with doubts, he will rarely admit that he is in the wrong. He delays because he likes to be thorough, to verify his facts, and to consult all available records. He may be slow, but he is sure; it is necessary to be certain that there are no counter-arguments unmet.

And to give him his due, there is something to be said for his point of view. For although decision of character is a valuable asset, it is of different kinds and it may exist on a high plane or a low one. A decisive man may have abundant imagination, but be able to keep it in strict control; or his imagination may be feeble, and his decision may be due to inability to see more than one thing at a time. In the latter case, decision may imply great limitations, the limitations of a narrow outlook, or imperfect knowledge, or a slavish adherence to precedents and past custom. But it is fair to assume that when decision of character is mentioned it is meant in a favorable sense. In that sense it is undoubtedly mainly temperamental, and not easy to acquire; but habit also will play its part. It is a virtue to be thoughtful in decision, it is quite right that a man should see his way clearly before he irretrievably commits himself; but once he has all his facts before him, there is no sense in delay, and it is in every way desirable that he should cultivate habits of resolution. Every time that a knotty problem presents itself, if he brace himself to make up his mind, he receives an accession of strength for the next occasion, and every victory makes the next struggle easier to overcome. And, *per contra*, if he fail to exercise that will power, his irresolution is more and more confirmed, until the very thought of a dilemma acts on him as the anaconda upon the rabbit. Of all men, engineers have far too much active, executive, constructive work to do to allow themselves to be paralyzed by their own misgivings. It is better that they should make mistakes sometimes than be everlastingly hampered by the dread of making mistakes. The man of action will have more than his share of successes to counterbalance the failures, when vacillation and wavering will only lead to Doubting Castle and Giant Despair. Fortune favors the bully, and "our indiscretions often serve us well when our deep-laid plots do fail." We were once told of an engineer who, troubled beyond endurance over a case in which two alternative courses of action presented themselves, resolved to consult a friend with a reputation for decision for advice. He stated the case at length, the pros and cons, his fears and objections, the advantages and disadvantages, and begged his brother officer to decide for him. He agreed, on one condition; he would decide, but his decision must be accepted without reasons. Reasons, he said, would only lead to fresh arguments, and he had no time to devote to them. The condition was accepted. "Very well, then, come back in five minutes and I will let you know." In five minutes he made his pronouncement, it was followed, and ultimately led to satisfactory results in every possible way. Years afterward the waverer expressed his gratitude, but hoped that he might be informed of the reasons on which the decision was based. "No, no," he said, "I won't give you the reasons, you wouldn't like them." "But I will—I must—you were quite right, the results show you were right. Do tell me." "Well, it was a difficult case, I had doubts myself, but one has to make up one's mind. So while you were away, I just—but perhaps I had better not tell you." "Yes, yes." "Well then, I just tossed up."—*Indian Engineering, of Calcutta.*

HANDLING METALLIC PACKING IN ROUNDHOUSES.

By A. E. M.

Since the advent of the superheater, and even before, the matter of keeping piston and valve rods packed has been and is a "live issue." A few words at this time on this matter, consequently, will not go amiss.

The writer having had the pleasure of visiting most of the railroads in the United States and Canada and observing different practices in use in the matter of handling metallic packing matters, more especially in the roundhouses, has come to the conclusion that especially at all large roundhouses it will be found to be one of the best-paying propositions to have a good machinist assigned to do all the packing of piston, valve and air pump rods. If such a man is onto his job he can save his wages very easily, and then some, to use a slang expression. It is reasonable to suppose that the man who would be held responsible will see to it when he packs a rod that that rod is packed in the best possible manner to insure its running without blowing until fully worn out. He will see to it that the equipment is in good shape and the swab well lubricated, as he will realize that if his work is not properly done he will have the same job to do over again the next time the engine gets back, if the work has not already been done at some other terminal in the meantime.

The packing man should be furnished a small pocket record book wherein he should keep a complete record of all rods packed during the day. A printed form should then be used in reporting to the division master mechanic each week all rods packed during the week. These records would indicate, should an engine be packed quite often, that something was wrong. Investigation would show why so much packing had been applied and the proper remedy to overcome the trouble would then be applied.

In other words, the packing man would become a specialist in his work. He certainly would try and make a showing. To do this he would make his business a study, that he might make such a showing. He should be encouraged as much as possible by the roundhouse foremen and others, who would see to it that guides, pistons, etc., were put in good shape whenever the packing man would make request on him that such work be done in order to help packing conditions. On a few roads it has been found advisable to have a monthly inspection of pistons, piston rings, etc.; this, of course, on superheaters only. On such inspection days the packing man should also look over his packing and equipment and see to it that it is in good shape to be replaced. The proper and best time to do any work necessary on vibrating cups, followers, etc., is while the piston and equipment is down.

It will be found that on a road where this practice is carried out and watched that there will be practically no packing troubles. If there are any, the division master mechanic can very easily trace it down and stop the trouble. His weekly packing sheets will keep him advised just what is being done and what points use the most packing, etc. His clerk can make a diagram or line monthly report for the general superintendent of motive power, if desired, but the main object and result would be that the rods will be packed right and a great deal less packing used, and packing troubles will be eliminated.

"SAND."

I observed a locomotive in the railroad yard one day;
It was waiting at the roundhouse, where the locomotives stay;
It was panting for the journey; it was coaled and fully manned,
And it had a box the fireman was filling full of "sand."

It appears that locomotives cannot always get a grip
On their slender iron pavements, 'cause the wheels are apt to slip;
So when they reach a slippery spot their tactics to command,
And to get a grip upon the rail, they sprinkle it with "sand."

It's about this way with travel along life's slippery track,
If your load is rather heavy, and you're sliding back;
If a common locomotive you completely understand,
You'll supply yourself in starting with a good supply of "sand."

If your track is steep and hilly, and you have a heavy grade,
And if those who've gone before you have the rails quite slippery made.
If you'd ever reach the summit of the upper tableland,
You'll find you'll have to do it by a liberal use of "sand."

If you strike some frigid weather, and discover to your cost
That you're liable to slip upon a heavy coat of frost,
Then some prompt, decided action will be called into demand,
And you'll slip 'way to the bottom if you haven't any "sand."

You can get to any station that is on life's schedule seen,
If there's fire beneath the boiler of ambition's strong machine,
And you'll reach a place called Flushtown at a rate of speed that's grand,
If for all the slippery places you've a good supply of "sand."

—*Coal Trade Journal.*

Tool Room Methods at Angus Shops

By W. M. Whitehouse, Tool-Room Foreman.

The Canadian Pacific Railway tool shop at Montreal, Que., (Angus shops) is located on the gallery of the main locomotive shop and covers an area of about 5,700 square feet. The organization is divided into three departments, each represented by an energetic assistant whose duties are to personally supervise the work in progress of manufacture or repair; such as:

1st, the making and repairing of milling cutters, taps, dies, reamers, press tools, gauges, jigs and fixtures, drop forging and upsetting dies.

2nd, the building of special machines, and the overhauling and repairing of all machine tools.

3rd, the supervision of forging, tempering and grinding of all lathe and planer tools. This includes the inspection and renewing of all emery wheels.

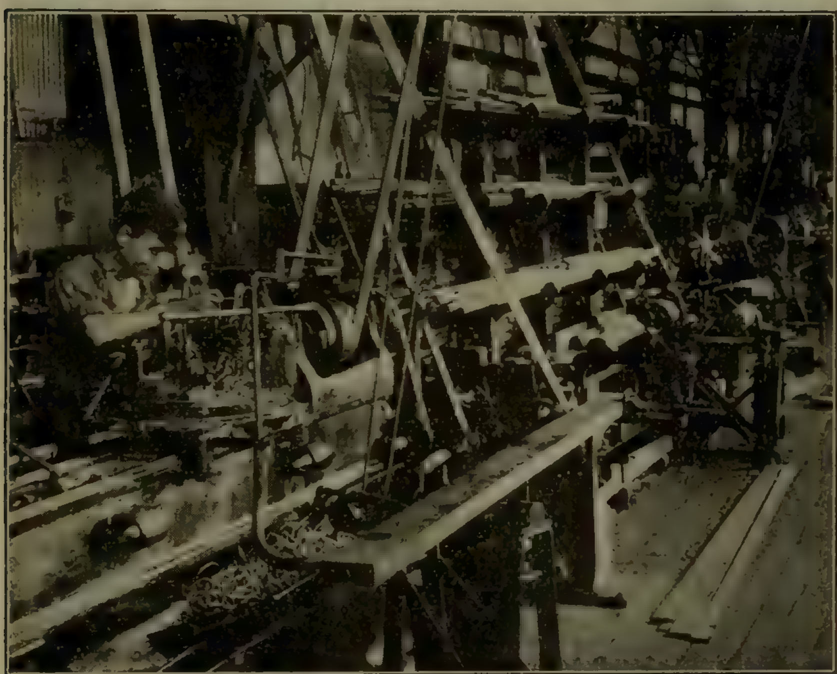


Fig. 1—Tool Steel Rack and Cutting Off Machine.

The main distributing tool room is located on the ground floor in the center of the erecting and machine shops and contains the necessary standard tool racks and shelves for the storage of drills, taps, etc.

The boiler and brass shops have storing and distributing tool rooms located in their own departments. This arrangement not only saves the workman's time in walking to and from the central tool room, but enables the boilermakers and brass finishers' tools to be kept separate. It also tends to relieve the congestion that would occur every Monday morning; the rule being that all tools must be returned to the tool rooms by the men before quitting on Saturday.

A record is made of all checks not redeemed, and the foremen notified of the men in their departments who have neglected to return the tools. It is the foreman's duty to investigate and ascertain the reason for their neglect.

All orders for repairs or new tools must be written on the company's special foreman's order form, and are not accepted until the same has been entered in the tools and machinery account book, and stamped with the superintendent's office stamp.

When the work has been completed it is returned to the central tool room and checked off by a clerk. When an order is first received it is considered by the tool shop foreman who makes the necessary sketches and orders such forgings or castings that may be required, after which it is turned over with the instructions to the assistant who is responsible for the making of the tools required.

Fig. 1 shows the tool stock rack, and the high speed power hack saws, which are attended to by a first-year apprentice, whose duties are to cut off (center if necessary) and distribute to the various machines the stock required to fill the order. Note the double purpose of the rack—it acts as a stock carrier for the turret lathe.

Should the order be for a lathe or planer tool to machine some special casting, the assistant assigned to this duty at once goes to the blacksmith shop, gets the tool forged, attends to the grinding, tempering and delivery. If a standard tool is required it is taken from the stock cupboard and delivered by a tool carrier whose duties are to collect and deliver tools to the various machines throughout the shops.

Fig. 2 shows the grinding and tool sorting room, with a Sellers tool grinder and twist drill grinder; also the flange forming tool grinders and the stock cupboard in the background. On the bench is an assortment of wheel lathe roughers, flange formers and finishers, also the broad finishing tools for the inside bore of tires.

Believing in the old saying that "A good workman is always known by his chips," the same must surely apply to a tool that can cut off such healthy looking chips as seen in the illustration. It is our practice to purchase only the larger sizes of high speed steels as used on wheel lathes and frog planers. When such tools become too short they are drawn down to the next standard sized tool and also on down to ½ inch square for brass finishing tools.

Unlike the manufacturing tool shops who specialize in certain lines of tools, the railway tool shop must be flexible and readily lend itself to the making of some special intricate tool or gauge or to the manufacturing of such standard tools as boiler shop punches, dies, staybolt taps, reamers, beading tools, pneumatic chisels, snaps, wheel defect and tire gauges, smoke box netting gauges, etc.

At Angus, beading tools and pneumatic chisels are manufactured in two and three hundred lots, while such tools as staybolt, mud plug and spindle taps are made in such quantities that seems most advisable in the judgment of the tool shop foreman. The main object is to always have a stock on hand, thus enabling the old and worn-out tools to be exchanged for new ones.

Fig. 3 shows a few of the many staybolt taps, reamers, etc., that are used in the boiler shop. Note the method of making

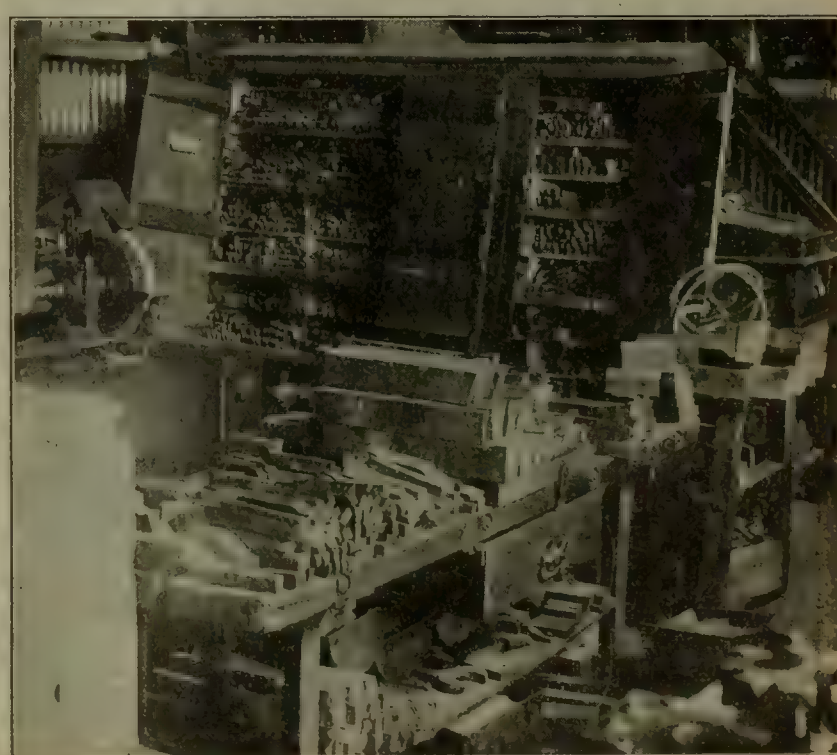


Fig. 2—Grinding and Tool Sorting Room.

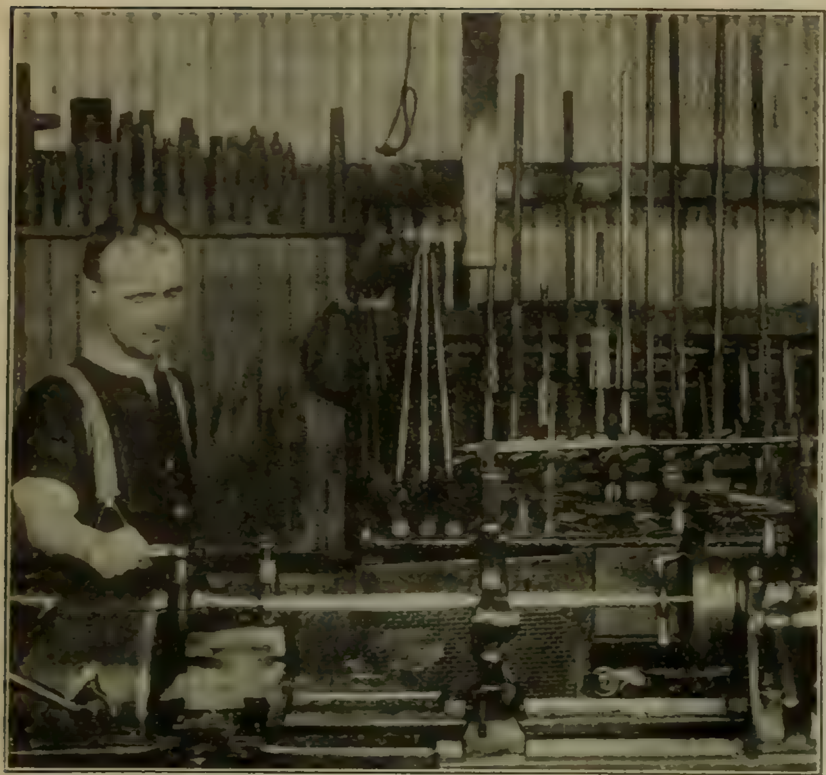


Fig. 3—Boiler Shop Tools.

long crown bolt taps, the shanks and pilots being screwed at each end, thus making it possible to reduce the essential part of the tap to 24 inches. The illustration also shows an operator filling an order for twelve staybolt taps 1 inch diameter, 11 threads, Whitworth standard, the stock being cut off and centered by an apprentice. They are then turned, threaded and chased on a 16-inch Pratt and Whitney lathe, after which they are taken to a milling machine and fluted four at a time, using a special fixture.

Fig. 4 shows the milling operation as generally done by a second or third year apprentice.

Fig. 5 shows the method of milling beading tools with the forming cutters and fixture at a rate of 270 per day of nine hours. The manufacturing operations of such tools afford a wide field for the training of apprentices.

Fig. 6—Mounted on a board are the various sizes and styles of tube expanders with the necessary tools, jigs and fixtures.

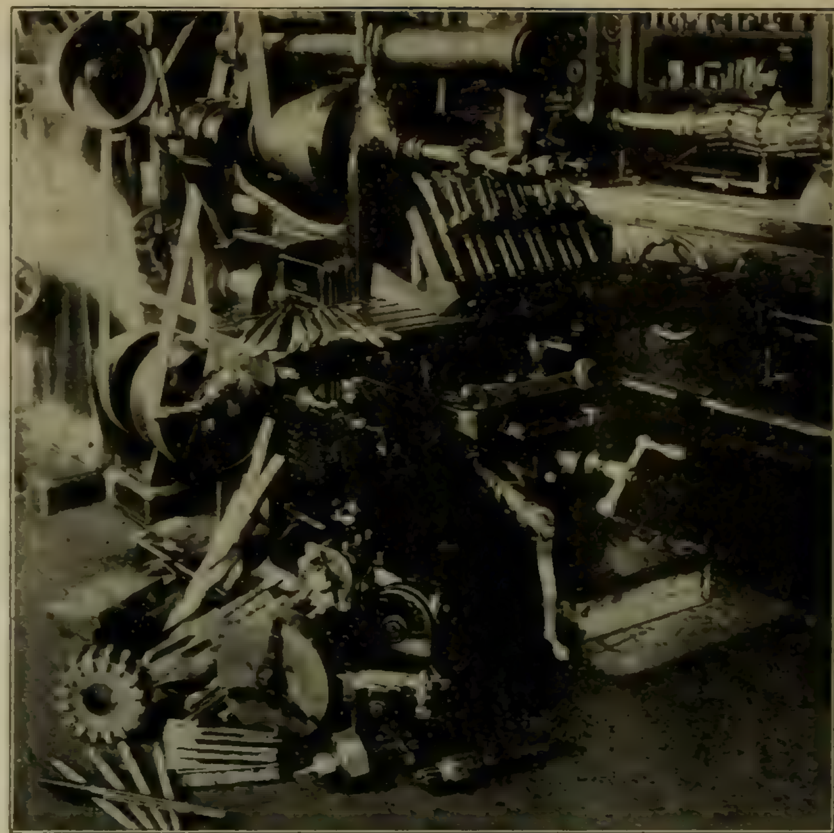


Fig. 5—Milling Beading Tools.

Standard blue prints giving the size, range, style and class of engine they are required for, are issued from the drawing office. Each expander and its various parts are given list numbers, which enables the stores department to issue orders as per list and blue print, in quantities large enough to fill all line orders.

MILLING CUTTERS, ETC.

Keeping pace with the modern trend of the times, the Canadian Pacific endeavors to keep to the front where the economical machining of locomotive parts are concerned. The high power milling machines and the well designed milling cutters are fast replacing the older methods of shaping and slotting, and are doing the work quicker, cheaper and of a superior quality.

Fig. 7 shows a group of the inserted blade and solid high speed milling cutters, and when it is known that we have over ninety sets of these inserted blade type of cutters, ranging

Fig. 4—Milling Cutters.

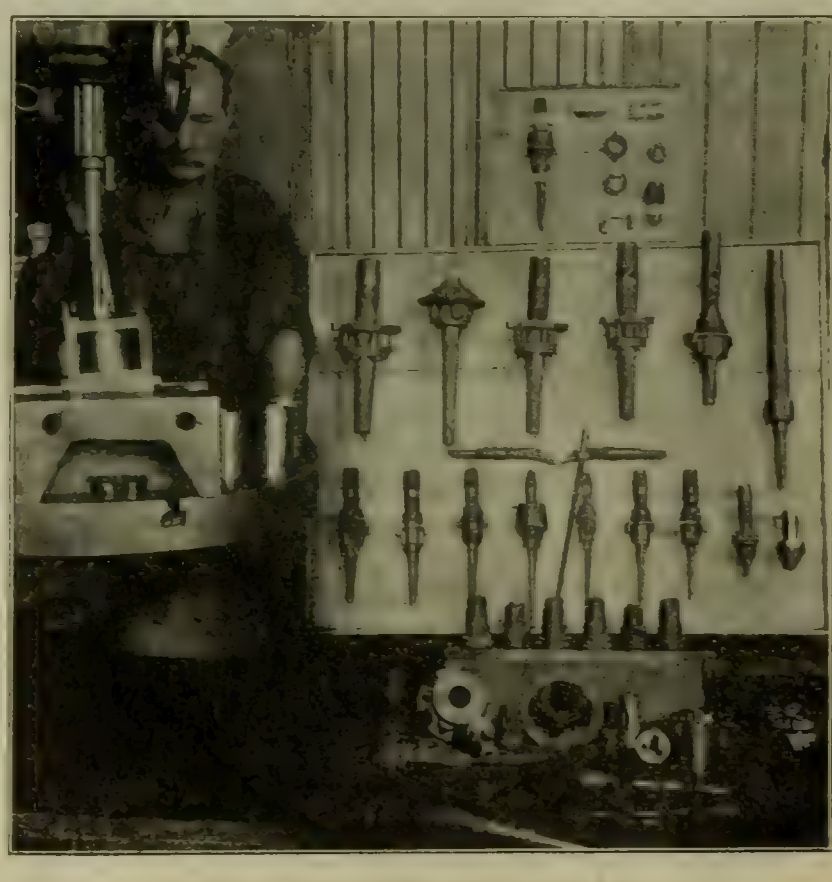


Fig. 6—Tube Expanders, with Jigs.

Fig. 7—High Speeding Milling Cutters.

from two to six cutters per set, it can readily be seen to what extent milling machines are used at Angus. The cutters shown include those for milling such locomotive parts as steel axle boxes, shoes and wedges, slabbing and fluting main and side rods, straps, fork ends, motion work, etc. The operator is grinding a set of concave cutters for radial truck axle boxes. These cutters are made of the inserted blade type and the form ground to the required radius with the special fixture bolted on a No. 2 Landis universal grinder.

All cutters for the larger machines are made interchangeable, the machinery steel blanks being drilled, bored and turned. A false table is mounted on a No. 4 milling machine and set over at an angle of 12 degrees. The slots are milled ½ inch wide by 1 inch deep, the cutting edge being radial at the beginning of the cut; and as the table advances the cutting edge gradually recedes from the center, thus giving the blade an increased positive rake. The blades are designed to interlock and project about ⅜ inch from the blank. After hardening they are caulked tight and the set of the required number are mounted on a mandril and ground on a Landis grinder.

When the blades become short through constant grinding, the cutters are taken to the milling machine and without removing the blades an angular portion of the blank is milled from the front of the blades, thus making practically a new set of cutters.

Attention might be drawn to the high power milling cutter with the pilot, also the arbor for driving the same and a comparison made in the development of cutters for the class of work such as milling the fork ends of side rods.

Following along the line of improved milling cutters we have developed our standard taper bolt reamers. These are made in quantities of twelve or twenty-four and are 12, 15 and 18 inches long, the material being a high grade of carbon tool steel. We have adopted five flutes for reamers, varying in sizes from ⅞ to 1½ inch diameter, with a lead of 18 inches and milled with a double angular cutter 60 degrees and 30 degrees.

Fig. 8 is a sketch of a standard four lipped tube sheet drill and reamer combined. It is made of high speed steel with a machine steel shank, the advantages of this tool being the use of a heavier feed, the reaming of the hole without changing the speed or tool, a much smoother hole and the size and life of the tool are retained much longer, making it possible to drill and ream 1,000 holes at one grinding. The success of these tools led us to adopt the same style for counterbores, as shown in Fig. 8 also.

Fig. 9 shows the style of flat high speed steel cutters with holders that are used for the finishing of brass castings in the brass shop, the box tools for machining valve spindles, tools for reseating inspirators, with a set of special tools for machining steel superheater fitting nuts. These nuts are machined on a Prentice semi-automatic lathe the tools consisting of jaws, cutters and the high speed flat tap which was adopted after considerable experimenting with all other styles.

GAUGES, ETC.

The system of making, checking and maintaining of gauges for locomotive driving wheels and tires is very strictly adhered to and is as follows: A maintenance regulation card is supplied by the drawing office which gives the correct diameter of the wheel centre, the bore of the tire and the shrinkage allowance. All gauges for new work are made and corrected to this card, the tire gauges are made ½, ⅝ and ¾ inch square, cast steel according to lengths. The centre or caliper gauge is made of ½x2 inch carbon steel. If more than one gauge of the same size is required they are lettered alphabetically A, B, C, etc., and must be sent to the tool shop at least every month to be checked and corrected on the standard check gauge and a Brown & Sharpe vernier caliper gauge, kept in the tool foreman's office. The foreman per-

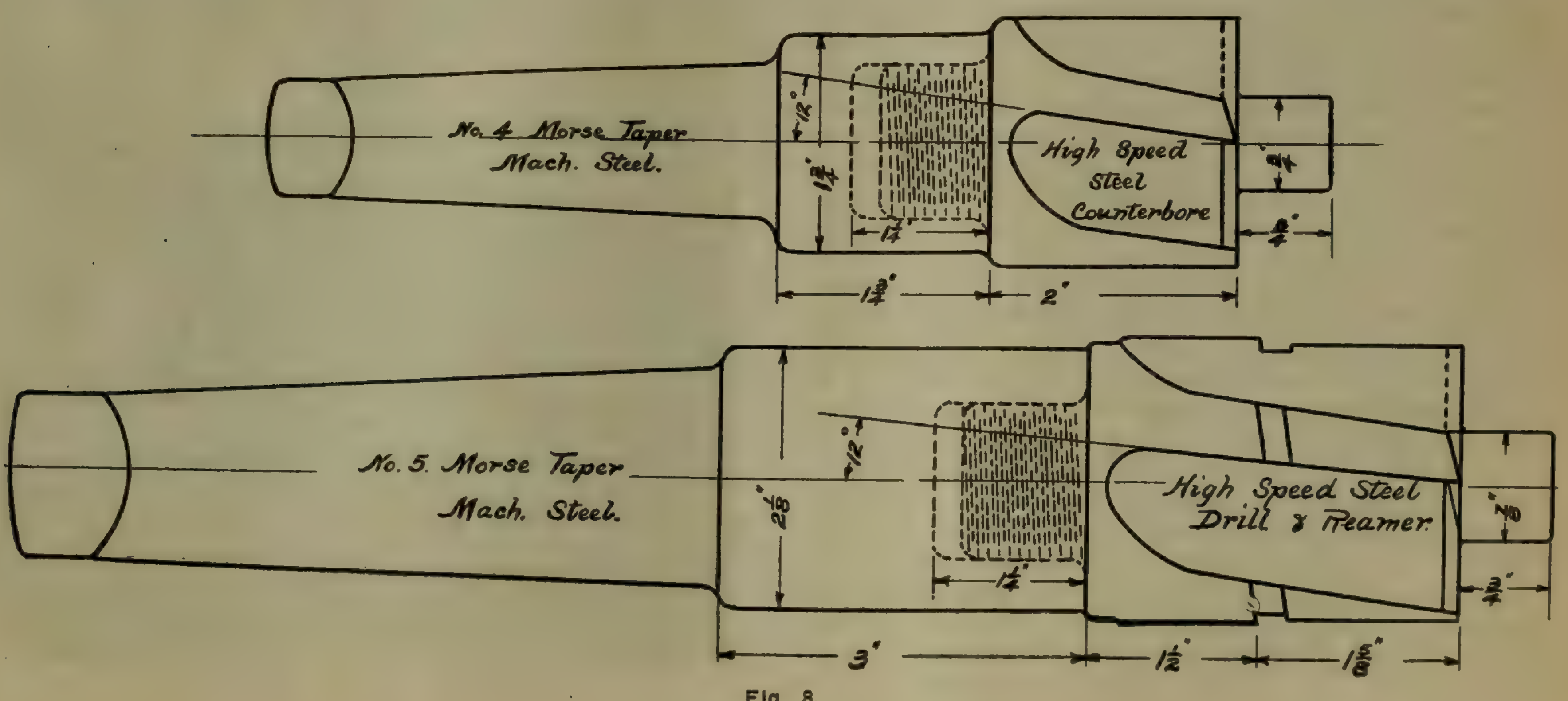


Fig. 8.

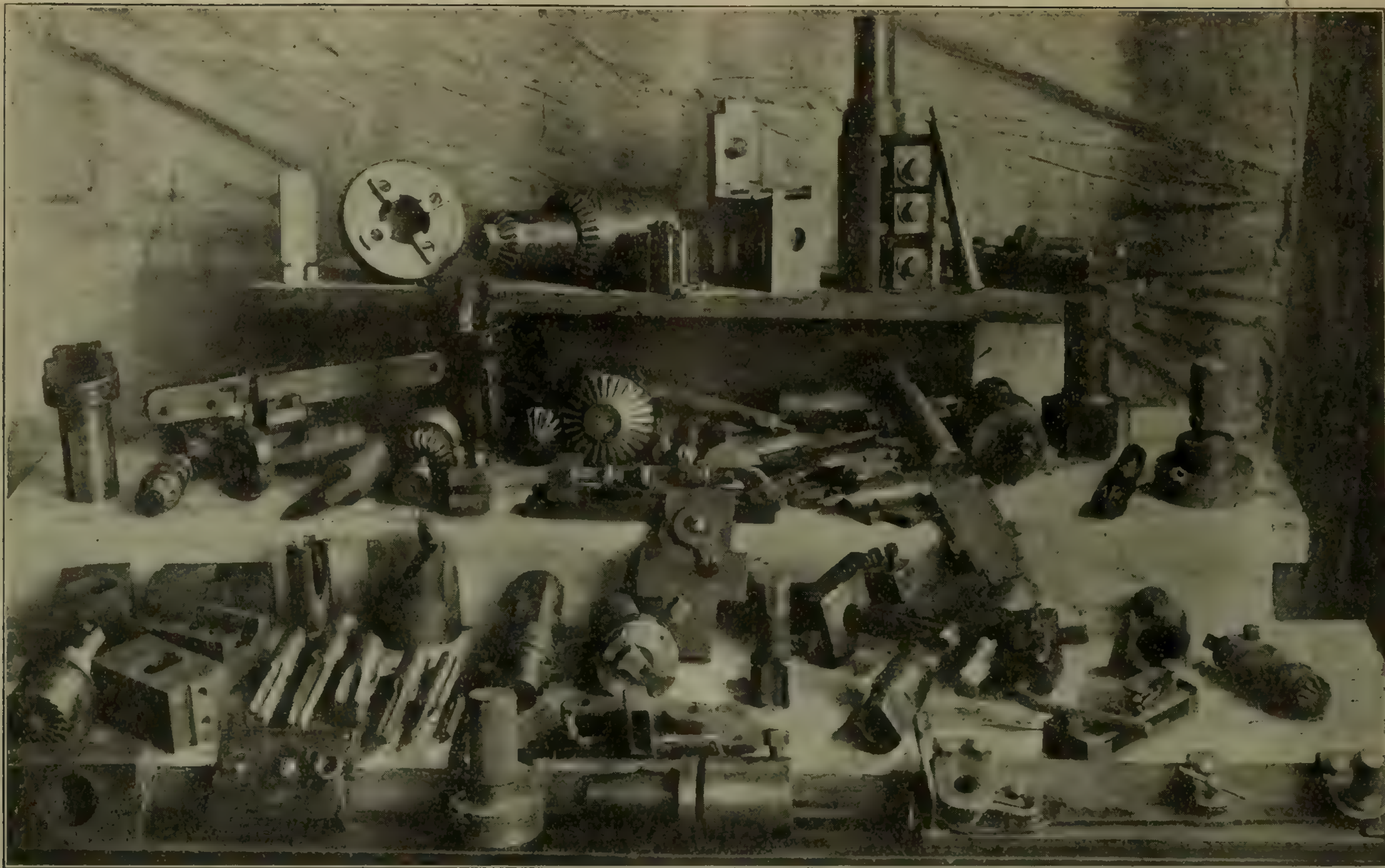


Fig. 9—High Speed Steel Cutters, Etc.

sonally supervises this work and also keeps a record of the condition of each gauge.

Fig. 10 shows a number of these gauges, including a variety of others such as profile gauges, wheel defect gauges, aluminum tire wear gauge, wheel check, tire thickness gauges, etc.

The outside adjustable caliper and micrometer gauges are used when shimming tires. They are made at Angus and supplied to all divisional points of the system.

The folding wheel check and needle gauge are designed to enable an inspector to put them in his grip when traveling on the road checking wheels for bent axles, etc.

PUNCHES AND DIES, ETC.

The blanking and forming of sheet metal on power presses "cold" and the upsetting and forging of metal on forging machines and drop hammers "hot" are coming more to the front every day. The field for this class of work is wide and the possibilities wider. The Canadian Pacific, realizing the wide possibilities, have installed such machinery that will produce the great variety of shapes and forgings required for shop and line at a cost far below the old style of producing such forgings by hand. Figs. 11 and 12 cannot but convince the reader that a great amount of time, money and patience have been invested on tools and equipment to produce such results.

Fig. 11 shows a few of the many sizes and styles of punches and dies. The ordinary boilermaker's punches are manufactured in quantities stocked in the tool shop and distributed to the tool rooms as required. The punches and dies for making the ordinary steel washers are made of high speed steel and make a complete washer at every stroke of the special machine, delivering same into a bag all ready to be weighed. These tools punch on an average 1½ to 2 tons of washers at one grinding. The material used for these washers is scrap plate. There are also tools for blanking split cotters, elevation plates for frog shop work, steam gauge mounting plates and grease cellar plates.

The laminated draw-bar plates are blanked hot under a hydraulic press. The pin and rivet holes are punched cold at one operation under a power press. On account of the various lengths of draw bars it was considered advisable to punch one end at a time.

Particular attention may be called to some of the tools used to blank the many parts required in the manufacture of oil cans, and headlight burners especially the punches and dies for making headlight numbers.

To the railway man Fig. 12 should require no words of explanation, the board with its samples of locomotive parts, the dies and trimmers for producing the same in larger quantities, cannot fail to convince him that this method of manufacturing is superior to the old method of hand forgings.

Our equipment for this line of work consists of a 1500 pound drop hammer and trimming press, a 3½ inch universal Ajax and a 5 inch forging machine. The only special machine required in the tool shop is a die sinking machine, the general railway tool shop machinery, such as lathe, planer, shaper, milling machine and drill press being sufficient to fill all other requirements. The making of these dies is assigned

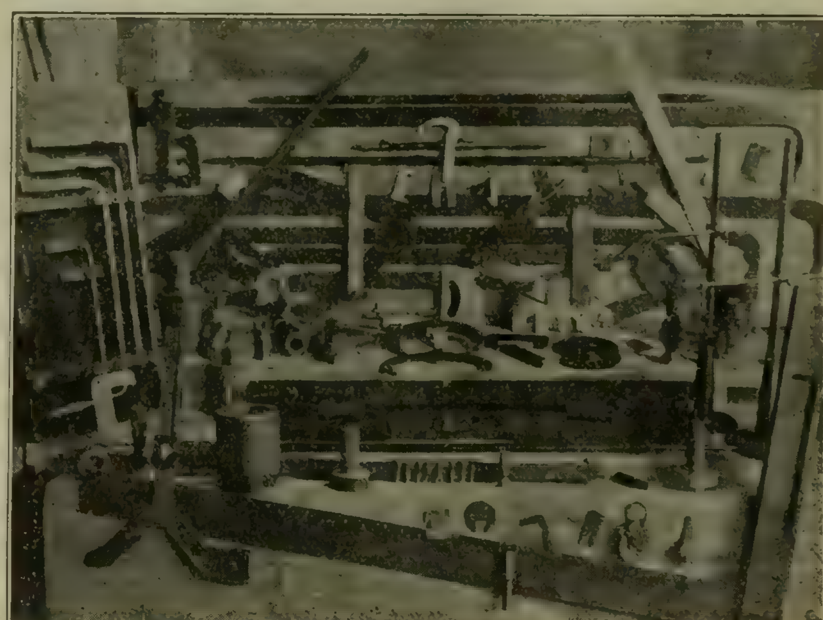


Fig. 10—A Variety of Gauges.

Fig. 11—Punches and Dies.

to a die sinker. A blue print is issued from the drawing office showing the forging required also a list and die number. The foreman of the tool shop, the die sinker and the foreman of the department for whom the work is intended consult and study the best possible means of making the dies. Attention might be called to the chain clevis dies. This clevis is forged, the flash trimmed, the holes punched and the clevis bent all ready to apply to the tender.

The dies for forging safety chain hooks have produced 5000 forgings and are still in first class condition. The slogan "Safety First" has been adopted by all railways and is making itself felt not only on the line and in the shops but on the engines as can be seen by the replacing of the old cast iron hand-rail posts for the more substantial and safer steel forgings. These are made in two operations, the ball end being first drop forged leaving sufficient stock at the other end to upset on a universal Ajax forging machine. After upsetting the forgings are trimmed at the same heat on the same machine.

Mounted on the board may be seen such forgings as, crosshead keys, eye-bolts, axle box wedges, superheater fittings and numerous others already familiar to the master mechanic.

Fig. 12—Dies and Trimmers.

The tool shop foreman also supervises the building of special machinery, the repairing of all machine tools in the locomotive and frog and switch shops and the overhauling and refitting of such machines that have been discarded from a central shop and replaced by modern machines, but are still fit for service in a back shop.

The methods adopted for the repairing and upkeep of this machinery depend largely upon conditions that govern the output of the various departments. In a great many cases the single purpose machine is used, for instance: frame planer, frame slotter, cylinder borer, cylinder planer, etc. The larger machines forming the base for the building of new equipment, it is most important that they be kept in good working condition during the period of filling an order for the building of a number of engines. Taking advantage of the intervals of setting up work on the machines to make any small repairs and sketches of any new parts required.

While it is impossible to foretell when an accident will cause a machine to break down, experience and familiarity with the machinery enables us to ascertain the breaking point or parts affected by excessive wear. The policy adopted at Angus shops is to have these parts finished or semi-finished; thus reducing to a minimum the time required to make repairs. Electric and oxy-acetylene welding are being used more extensively in the repairing of such machine parts as levers, brackets, etc., being not only time savers, but cost reducers and every advantage is taken of its possibilities. The results of welding are not only gratifying to the repair foreman who is thus enabled to make a quick repair, but to the foreman of the department to whom the machine belongs.

The system used in handling repairs to machines is the same as the one in use for the smaller tools, that is, when a machine breaks down or fails through some other cause, a foreman's order, giving the machine number and location is placed on the tool shop. The assistant whose duty it is to make the repairs, ascertains the nature of the failure and takes the necessary steps to remedy the same, always giving a preference to the larger or most important machines. The number of machines in the locomotive department is over six hundred and fifty, so you can see it is no easy task to keep these in good working condition.

WESTINGHOUSE AIR BRAKE PRIZES.

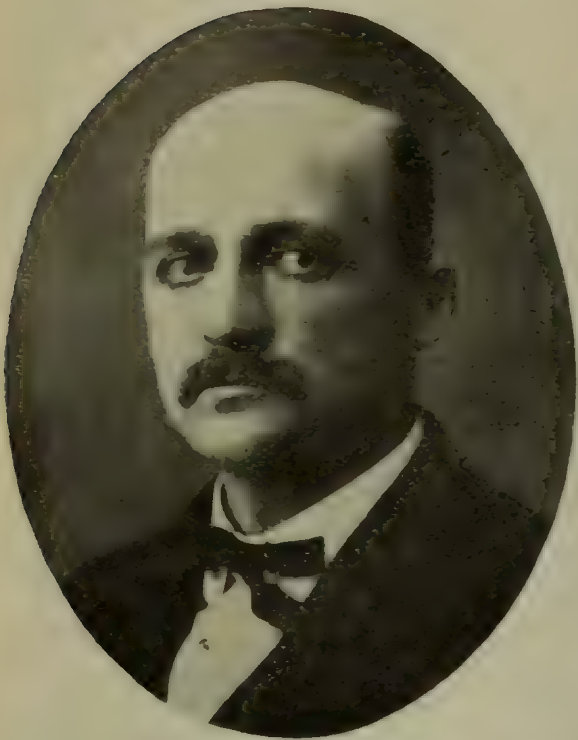
The sum of $2,000 in prizes has been offered by the Westinghouse Air Brake Company in several advertisements published in various technical journals during the last few months. The company stated that it would pay this sum of money for the six best stories submitted, under certain conditions, dealing with the experience and practical knowledge of railroad employees regarding any striking performance of the air brake manufactured by this company.

The history of braking railroad trains is replete with dramatic but unwritten narrative and the company believes that by offering this incentive a considerable amount of this material will be brought to light. The conditions stated that the story must be written either from the practical experience or the personal observation of the writer or from information obtained first hand from railway men who actually knew the facts related.

The contest closed August 1, 1914, and the committee of judges composed of the following men is now engaged in judging the entries: W. E. Symons, consulting mechanical engineer, Chicago; Willard Smith, editor *Railway Review*, Chicago, and R. V. Wright, managing editor *Railway Age Gazette*, New York City. Very considerable interest was displayed in the contest and a large number of stories were submitted, so that several weeks will elapse before the judges will be able to announce the winners of the prizes.

THE RAILWAY STOREKEEPERS' ASSOCIATION will hold its twelfth annual convention at the Hotel Sherman, Chicago, on May 17, 18 and 19, 1915.

Officers of the Traveling Engineers Assn.



F. P. ROESCH, M. M. El Paso & Southwestern R. R.; Pres. Traveling Engineers' Association.

ROBERT COLLETT, V. P., Traveling Engineers' Assn.

J. C. PETTY, Trav. Engr., N. C. & St. L. Ry.; V. P. Traveling Engineers' Assn.

J. W. HARDY, Fuel Engr., Southern Coal, Coke & Mining Co.; 3rd V. P., Traveling Engineers' Assn.

W. O. THOMPSON, M. C. B., N. Y. C. & H. R. R.; Sec. Traveling Engineers' Assn.

DAVID MEADOWS, Asst. M. M., Mich. Cent. R. R.; Treas. Trav. Engrs' Assn.

Officers of the Railway Equipment Manufacturers Assn.

FRANK H. CLARK, Pres. Chambers Valve Co.; Pres. Ry. Equipment Mfrs. Association.

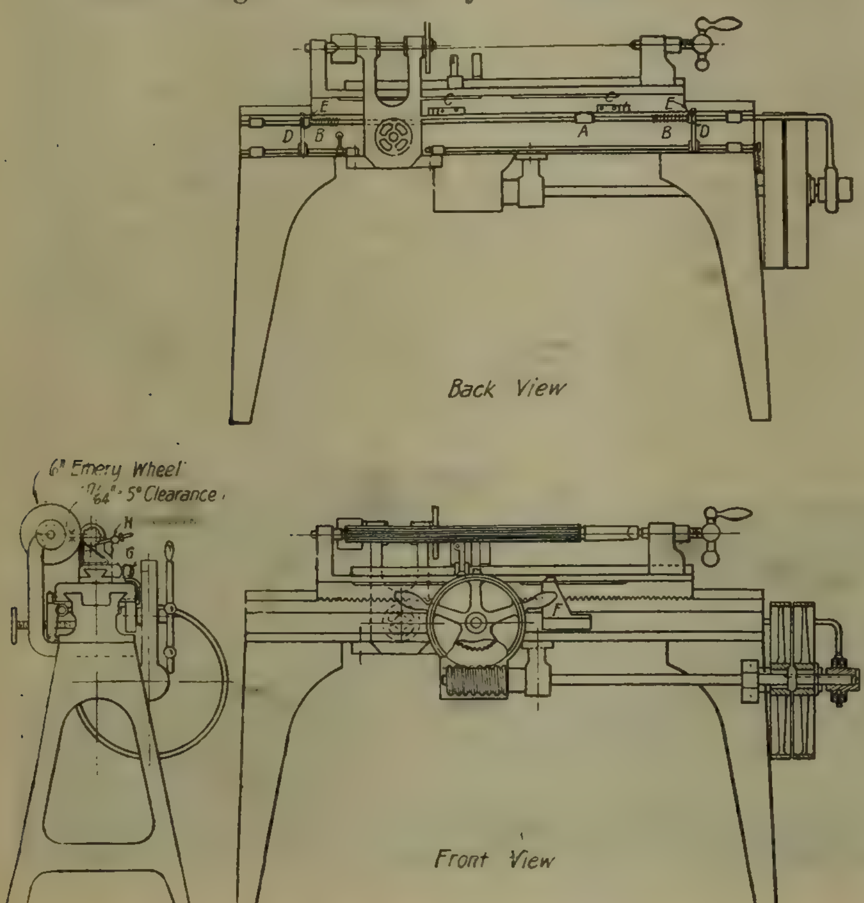
WM. S. FURRY, Ohio Injector Co.; Sec. Railway Equipment Mfrs. Assn.

P. H. STACK, Galena-Signal Oil Co.; Treas. Railway Equipment Mfrs. Assn.

AUTOMATIC REAMER GRINDER.

By W. C. Diebert, Tool Fmn., C. & O. R. R.

I have just finished and tested out an automatic reamer grinder and it has proved a very good tool. The illustration shows it applied to the grinder. As the carriage nears the end of its travel the collar (A) compresses spring (B) and as it reaches the extreme travel the stop (C) comes in contact with dog (D) and lifts the dog, releasing spring (B). This forces the clutch rod forward, reversing the carriage. The same operation takes place at the other end of travel. The reamer is revolved one flute at a time by means of the device shown in the end view. As the carriage reaches the reversing point the roller (G) comes in contact with stop (F) (see front view) and forces finger (H) forward, revolving the reamer one flute. The clearance angle is obtained by the difference between the wheel center and reamer center. For our large frame reamers we use a 6" wheel and 17/64" above reamer center, giving a 5 per cent. angle. This tool has been tested out and gives good results. It is very simple and durable.



Automatic Reamer Grinder.

HE TOOK CHANCES AND CHANCE TOOK HIM.

By Berton Braley.

Here lies Antonio Herrowitz,
Or what is left of him.
He was a man of splendid build,
Of vigor and of vim.

He never feared to take a chance,
Wherever he might be;
He'd take a chance the roof was safe,
He would not look to see.

He'd use a drill to tamp a charge,
And take a chance on that;
He'd smoke in any gassy place
He happened to be at.

And when he rode upon the cage
He would not grasp the bar;
He never looked upon the board
Where rules of safety are.

But, being full of health and strength,
And quite devoid of fear,
He played at hide and seek with death,
And now he's lying here.

He took a chance with dynamite,
He took a chance with damp,
And in the very prime of life
Fate snuffed his miner's lamp.

He's done with taking chances now,
He's done with mines and such,
And what is left of him lies here;
He took one chance too much.

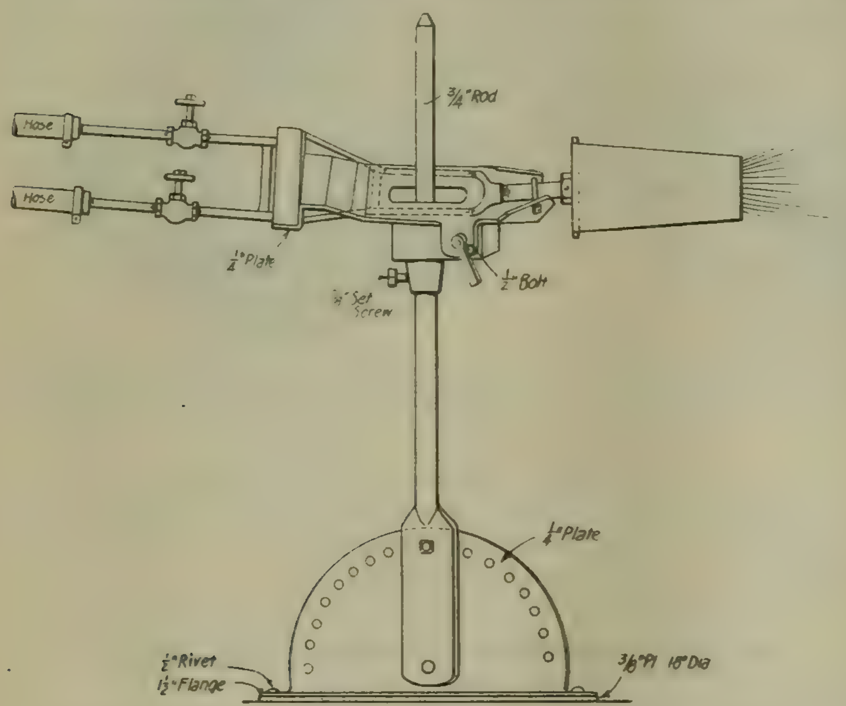
—*Coal Age.*

GAS-ELECTRIC MOTOR CARS, ST. L. S.-W. RY.

The St. Louis Southwestern has commenced to place in operation the first lot of eight gas-electric motor cars that are now being received from the General Electric Company.

Car No. 10 is now making the trip between Shreveport, La., and Lewisville, Ark., a distance of sixty-two miles. Along the route are ten regular stops, seven flag stops and four railroad crossings. The time required for the run is 2 hours and 30 minutes. The car, however, makes one trip each way per day, totaling 124 miles. Car No. 11 recently made the initial run between Commerce and Sherman, Tex., a distance of fifty-seven miles. The car left Commerce at 8 a. m. and arrived at Sherman at 10:40 a. m. Returning, it left Sherman at 4 p. m. and arrived at Commerce at 6:40 p. m.

In the formation of the St. Louis Southwestern Railway are



Side View of Adjustable Frame Device for Oil Burner.

included the Pine Bluff Arkansas River Railway, the St. Louis Southwestern Railway of Texas and the Eastern Texas Railroad. It is known as the "Cotton Belt Route" and has a total mileage of 1,810 miles. Starting at St. Louis, Mo., it follows a southwesterly direction across Arkansas into Texas. Here, at Mount Pleasant, one branch terminates at Fort Worth and the other runs through Waco to Comanche and to Stephenville. Numerous lines of the road connect with important centers like Cairo, Ill.; Memphis, Tenn.; Little Rock, Ark. and Dallas, Tex. The equipment of the road comprises 242 locomotives, 235 passenger cars and 12,445 freight and miscellaneous cars.

All the gas-electric motor cars for this railway company are what is known as type RE-70-B-11. The details of construction conform in general to those of the standard cars manufactured by the General Electric Company. The specific dimensions of the St. Louis Southwestern cars are 70 ft. 1⅜ in. over bumpers by 10 ft. 6⅜ in. wide over all. They weigh approximately 49 tons, have a seating capacity for sixty-two passengers, two per seat, and are each equipped with two GE-205, 600-volt, box-frame, oil-lubricated, commutating-pole railway motors having a total of 200 hp. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. The generating unit consists of an 8-cylinder 4-cycle gas engine of the "V" type, directly connected to a 600-volt, commutating-pole electric generator, designed to meet the special conditions the service demands.

The interior of the cars is partitioned into four compartments. The cab in front containing the power plant apparatus measures 11 ft. 11 in. long; next is the baggage room, 10 ft. 11⅞ in. long; then the smoking section, 12 ft. 5 in. long; and the passenger compartment, 30 ft. 5⅞ in. long. The track is standard gauge.

A "SAFETY FIRST" OIL BURNER.

By H. A. Lacerda, Asst. Boiler Insp., N. Y. C. & H. R. R.

The oil burner shown in the illustration is in use at the West Albany shops of the New York Central & Hudson River. In using oil burners in the various shops throughout the country for laying up corners or flue sheet flanges, they are usually placed on a block of wood or hung on a wire. This often proves dangerous and we have had a few accidents on this account. This device does away with all the trouble and I believe it will be of great value to other shops. The cost of making it is about $2.00.

"WANTED—the man who will accept the responsibility for the things he can do and do them; for the things he cannot do and get them done."

When asked how near the truth we thought the above came we said we would put it this way:

"WANTED—the man who will accept the responsibility for the things that he criticizes and do them the way he says they should be done."

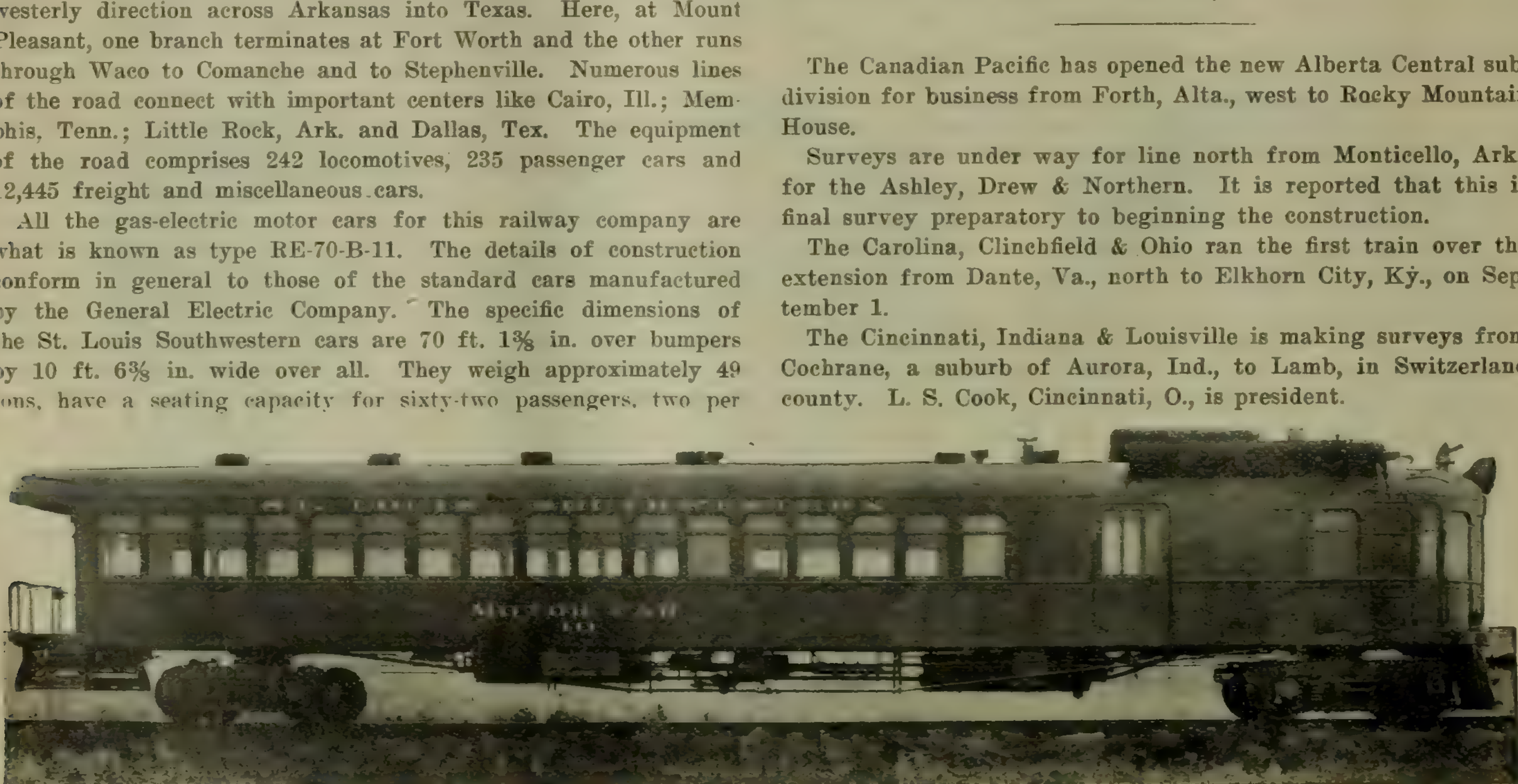
Frequently a man will make a kick to the management about something and then tell how it should be done, but if the management puts it up to him to accept the responsibility and do it in the way it should be done, nine hundred and ninety-nine times out of a thousand he backs out, and sometimes when he does not back out and undertakes the job he will come back and lay it down and acknowledge that "probably the other fellow did it about as well as it could be done."—*Graphite.*

The Canadian Pacific has opened the new Alberta Central subdivision for business from Forth, Alta., west to Rocky Mountain House.

Surveys are under way for line north from Monticello, Ark., for the Ashley, Drew & Northern. It is reported that this is final survey preparatory to beginning the construction.

The Carolina, Clinchfield & Ohio ran the first train over the extension from Dante, Va., north to Elkhorn City, Ky., on September 1.

The Cincinnati, Indiana & Louisville is making surveys from Cochrane, a suburb of Aurora, Ind., to Lamb, in Switzerland county. L. S. Cook, Cincinnati, O., is president.



Gas-electric Car for the St. Louis Southwestern.

Master Blacksmiths' Convention

The twenty-second annual convention of the International Railroad Master Blacksmiths' Association was held at the Hotel Wisconsin, Milwaukee, Wis, on August 18, 19 and 20, 1914. The meetings were presided over by H. E. Gamble, president. In the president's address Mr. Gamble made special reference to the "Safety First" movement. The convention was also favored with an address by H. C. Manchester, superintendent of motive power of the Chicago, Milwaukee & St. Paul. Extracts from some of the papers and reports follow:

High-Speed Steel

By George F. Hinkens, Wilmerding, Pa.

To determine the proper forging heat is a matter of experience on the part of the toolsmith. Anywhere from 1,650 degrees F. to 1,900 degrees F., dependent on the different makes of alloys, is the forging heat used. To ascertain the best forging heat, let the toolsmith experiment with the particular brand he is to use and forge at the highest heat it will stand. Care must be exercised not to work high-speed steel at too low a heat—forging below the point of transformation, said transformation depending on the alloys. Forging high-speed steel below this point will cause the crystals to crush and rupture. The point of transformation is termed "non-magnetic," or the point of refinement, or that point which releases any strains, or the point of uniformity or equilibrium throughout all parts of the forging. At any rate, it is dangerous to forge high-speed steel after the temperature has dropped below a bright yellow.

There are as many methods for hardening high-speed steel as there are brands. One method that gives results in hardening high-speed steel is to heat slowly up to the sweating point, or about 2,200 degrees F., after which cool the cutting point of tool in oil (if lathe or planer tool), and when thoroughly black, cool rapidly in compressed air blast. In hardening taps, threading dies, reamers and milling cutters made from high-speed tool steel it is good practice to insist on slow preheating in a furnace at a temperature of 1,500 degrees F., and then submit to a temperature of 2,200 degrees F. or move to an adjacent furnace.

The Westinghouse Air Brake Company use a very simple method for annealing. They place the steel in a tube or pipe large enough in diameter and length to accommodate the work. Both ends of the tube are provided with a screw cap, which can be screwed on and off. After the work is placed in the tube and before screwing on the cap, put in from a tablespoonful to a handful of resin, screw on the cap, place in furnace at the proper temperature, heat for six hours and let the pipe and contents cool with furnace gradually to atmospheric temperature.

For work of large bulk place it in open furnace at 1,450 degrees F. and leave in furnace for six hours, then remove and bury in hot burnt case-hardened compounds or extremely hot ashes and let remain until cold.

The furnace should be so constructed that the oxygen of the air from the blast and fuel opening will not attack the metal, as this would result in scale, blisters, uneven heating, cracking in hardening and general bad results. The furnace within heated from the furnace without by flames that are not permitted to enter the inner furnace would be the ideal. Such a furnace would prevent the oxygen of the air from attacking the work and would be suitable for large pieces, such as drop hammer dies. For smaller pieces a muffle should be used.

Tools and Formers

By J. W. Riley, Blkms. Fmn., L. V. R. R., Sayre, Pa.

Dies for forming wrenches from scrap spring steel under the Bradley hammer are shown in Fig. 1. These dies can also be used under a steam hammer. By this method a wrench can be made $\frac{5}{16}$ inch thick from 3/8-inch scrap spring leaves. The wrenches are forged in two heats and one man can forge on an average of 150 blanks in ten hours. After they are forged they are punched hot on a power punch with a close fitting die and, after being punched, are rattled until they are polished. These wrenches are sized on a small emery wheel, by grinding $\frac{1}{32}$ inch. One man can grind 300 in ten hours and one man will heat and punch 300 in ten hours, in sizes from 3/8-inch to 1¼-inch.

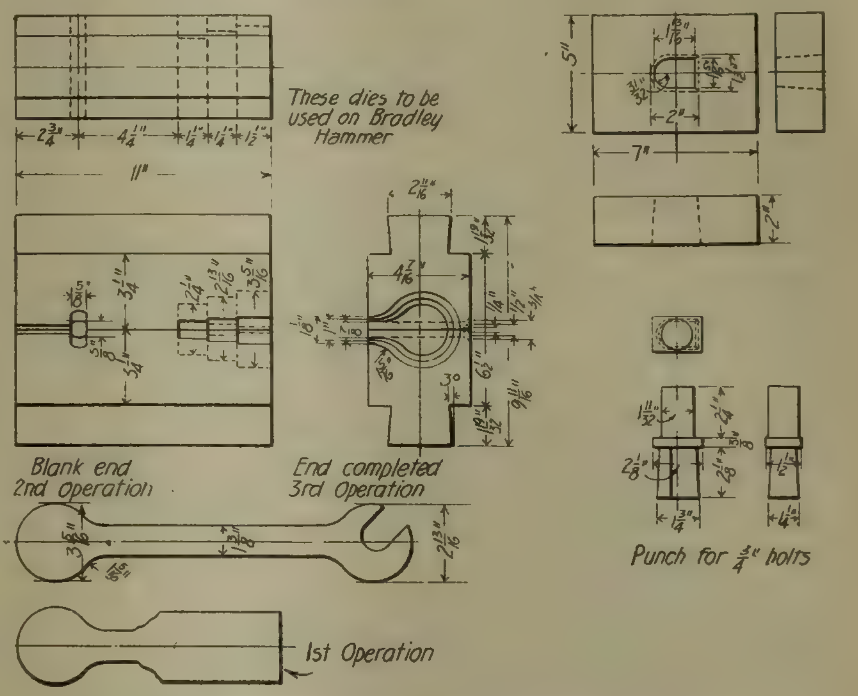


Fig. 1—Dies for Forging and Punching Wrenches.

By this same method we also make wrenches up to 2-inch. Any wrenches which are too large to be made from spring steel are formed from tire steel to the required size and the steel is then sheared off to the proper length required to make the wrench, the same as we do with spring steel after it has been annealed.

We have made for the Lehigh Valley during the past eighteen months 4,500 wrenches, and they are well pleased with them. These wrenches are made from hard steel and, therefore, there is no wear on the jaws.

Fig. 2 is a small tool for bending cellar bolts. This die can be used on any power punch by having the plunger out far enough to clear the front. With this tool a bolt can be bent every stroke of the machine and the short ends can be worked up into cotter pins.

During the past year 400,000 grab irons were forged in the system shops of the Lehigh Valley at Sayre, Pa. The following is the best record made by four men:

Upset the foot on 6,430 ends complete in ten hours, two men.

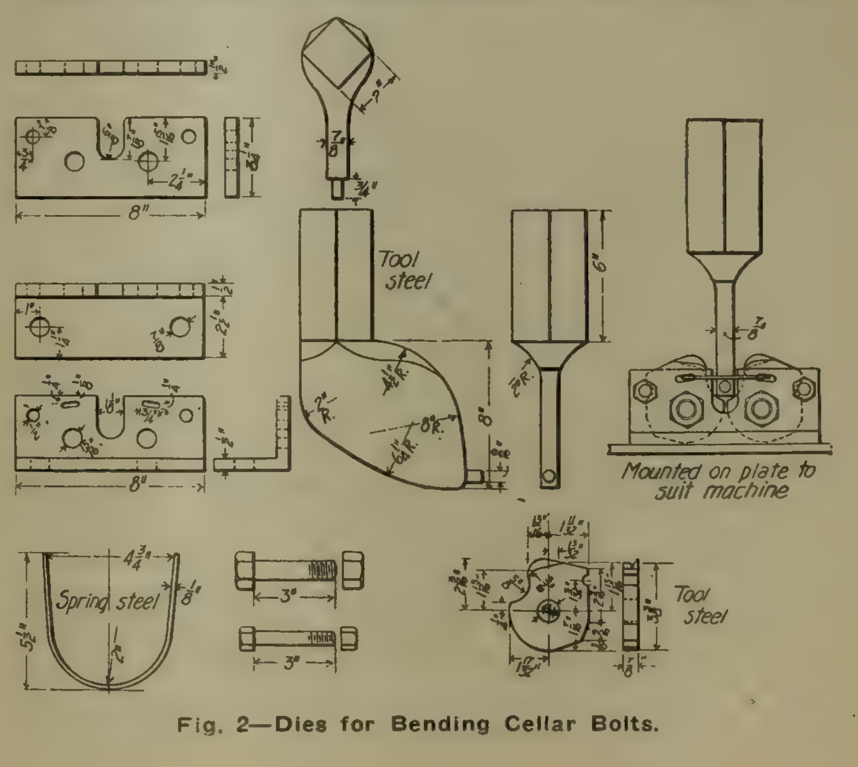


Fig. 2—Dies for Bending Cellar Bolts.

Punched and trimmed the burrs on 10,000 ends in ten hours, one man.

Bent under punch (single bend) 9,000 ends in ten hours, one man.

The machine for punching is one of the old four-hammer bolt machines, with the side and bottom hammers removed, a shear blade attached to the top hammer and a bottom shear blade placed across for shearing the burrs off. The only burrs we have are on the bottom of the foot, as the hole is punched nearly through by a button on the header—it does not require much to punch the hole through. A punch die is arranged in front of the shear blade and the punch is attached to an extension bar which is placed in the header holder. The machine runs sixty-five strokes per minute.

The punching of the hole only partly through, with button on the header, serves three purposes:

Ninety feet of iron is saved on 1,000 grab irons.

The button hole serves as a perfect gauge when upsetting the second end to keep the feet perfectly in line, so there is no twisting to do.

By punching the button into the foot the stock is forced out,

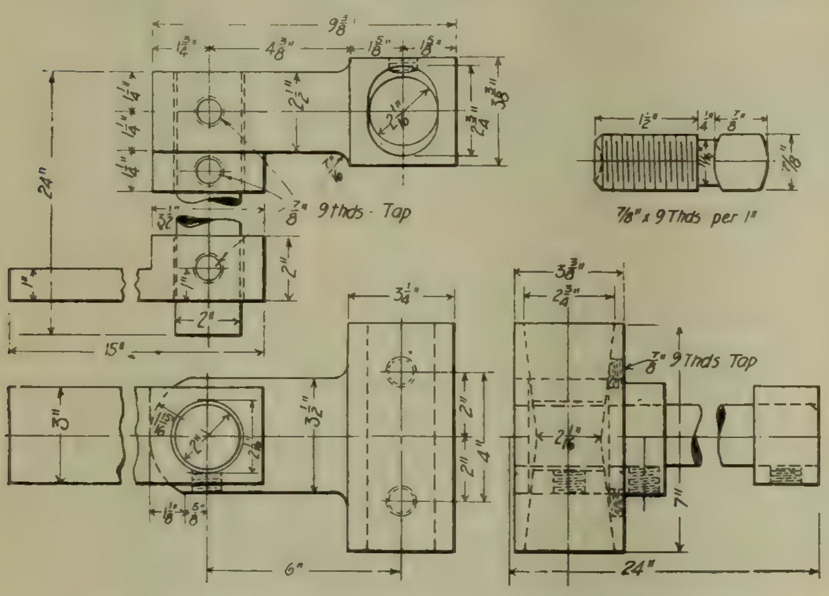


Fig. 3—Adjustable Holder for Thermit Crucibles.

forms a perfect foot and leaves so small an amount to punch that there is no strain on the foot in punching.

Fig. 3 is an adjustable Thermit crucible holder which is very handy for raising and lowering the crucible when working in close places, as it gives an adjustment of 6 inches.

Drop Forgings

By F. F. Hoeffle, L. & N. R. R., Louisville, Ky.

The manufacturing of forgings by stamping the same at the drop hammer can virtually be understood and termed as machine blacksmithing. Developments along these lines have continued in recent years and by close observation they have been greatly improved and the products of the drop forging industry are now used in a great variety throughout the entire world of mechanical arts.

Drop forgings are understood to be made in suitable dies, which are in two parts. The separating lines of the two parts must be considered which will give the best advantage to the article that is to be stamped, the greatest flow of material to meet the force of the blow, also the proper breaking down of the raw material, in order to cause the least resistance of pressure against the dies under the force of hammer blows. Again, to consider the proper clearance of the two parts (dies) that will provide for the necessary relief for the overflow of material, a stripping press is required, equipped with proper stripping dies by which the forgings can be cleanly stripped of all overflow material. The stripping press is a very important member of the drop hammer equipment.

One part, known as the top die, is fastened in the ram or hammer itself, which moves vertically between two uprights or guides. The second part is arranged in the anvil or base of the hammer. In the operating of the drop hammer the ram rises until released, then descends and strikes the heated bar metal which is placed on the bottom die; the force of the hammer blow causes the hot metal to be forced into the impression in both top and bottom dies, and by a series of blows the complete forging is formed.

The necessary dies must be made to conform to a drawing of the article that is intended to be stamped, as this will facilitate the designing of dies. In the designing of dies the necessary draft should be allowed in order to prevent the forgings from sticking to the dies. It must be understood, of course, when designing dies, whether or not finish is to be allowed, and where general forgings are stamped very accurately, forgings that are to be stamped accurately can be made to a gauge by a redropping operation, and frequently, for extra nice work, it requires separate dies. This, of course, means additional expense. The endurance and cost of dies depends largely upon the work that is required from them.

A very good practice after the impressions have been sunk and completed in the die block and before the dies are hardened is to try them out by making a lead casting, which is understood to be a lead proof. Slight changes are sometimes necessary to be made, after which the lead proof has been submitted for inspection; hence it is quite important to be governed by a lead proof, as it is a very hard matter to alter dies after they have been hardened. If changes are to be made after the dies are hardened, the dies would first have to be annealed. The hardening of dies must be good and the equipment for the treating must be exceptionally good.

The steel that is to be used for die blocks must be suitable for drop work and in a measure depends largely on the character of the articles that are to be dropped.

Spring Making and Repairing.

By F. B. Neilson, Fmn. B. S., O. S. L., Pocatello, Ida.

We have two spring makers, one spring fitting furnace, rolls, punch, shear and press. The spring question is a troublesome one, and the tendency is, when failure occurs, to increase the spring with an additional number of plates. I have always been more or less opposed to doing this, as, in the first place, it causes confusion at outside points as well as in the store department. The first thing they do when ordering a certain number of springs is to count the plates in the same and where the spring has been increased a number of plates they get away from the standard. Another trouble that we have experienced is that the springs have not been marked when applied in roundhouse or outside points, and the result is when the spring is returned to shop for repairs we cannot give an intelligent report of the life of the spring, as we do not know the length of time it has been in service. We have overcome this trouble, and now when a spring is taken off of an engine it is marked with the number of the engine and date from which removed, and the same method is used when applied. By using this system we can keep account of the length of service the spring has given.

We are at the present time experimenting with Vanadium steel, but the spring not having been in service for any length of time, I am unable to furnish an intelligent report as to the results. From the test I have given it I am of the opinion that it is far superior to a low grade of carbon steel if properly treated. Do not handle Vanadium steel without the use of pyrometer, for if you do you can look for trouble.

By F. F. Hoeffle, L. & N. R. R., Louisville, Ky.

If the steel is good there can be no excuse for bad springs, and if the steel is not good, surely the springmaker can not make good by any subtreatment he might undertake. Competition among steel manufacturers is very close and the gradual introduction of open-hearth and Bessemer steel has made it even more so. The mechanical department wants the best material that it can get that will answer the purpose, and conditions contrary to present good work cause one to be placed "between the devil and the deep sea." Therefore, it is suggestive, to get results, that all connected must make an honest effort, give care and attention to every detail.

It can be assumed if the chemistry is correct, the physical condition good and the sizes of the steel plate accurate, that the steel maker's responsibility ceases. Good elasticity is expected. The elasticity of a spring is understood to be the amount which a

spring will deflect or bend, under a given load, without having its form permanently changed. If the bending or depression is so great that the spring will not recover its original form of set after which the load has been removed, the strain is understood to have exceeded the limit of its elasticity and if repeated often will surely break the spring.

The elastic strength of a spring is understood to be the strain it will bear without being strained beyond the limits of elasticity. The ultimate strength is the strain that will cause the spring to break. The strength depends, of course, upon the physical condition of the material of which the spring is made, and increases according to the number of plates the spring may have, the width, the thickness and the length.

The plates must diminish regularly in their lengths, for with a spring consisting of a number of plates each of uniform thickness and width, the springs should be set in a manner so that when they bear the greatest load they will carry it in almost a straight position. The spring operating in this position will display itself as flexible and elastic.

The condition of roadbeds has a great deal to do with the success and life of springs. Flat wheels and low joints are very bad factors, for whenever the flat wheel strikes or the wheel strikes a low joint, the tremble caused from that jolt will travel from the wheel base to the spring and its connection. As above stated, when the spring is constructed to ride and operate in almost a straight position in service, it will give a flexible and soft riding motion. On the other hand, if the springs are set too high the results would be a hard, quick, jerky and trembling motion.

A well-proportioned spring, when loaded and operating in service, will have as near as possible a uniform strength throughout. A spring well banded will cause an equal advantage to all plates contained in the spring and, all conditions being equal, not only its strength but the amount of deflection from any load will be distributed equally.

The elasticity of a spring is founded on the material of which it is made, the way it is tempered, the length, width and thickness of plates.

Although the difference in temperatures necessary to produce the best hardening for the different qualities of carbon are seemingly slight, as observed by the heat color, they are very important and are best obtained by the experienced eye of a man of good judgment. The hardening and tempering of springs is a comparatively simple matter if the temperer knows the carbon with which he is dealing. It would seem that if the spring maker was informed of the carbon he had to deal with the results at large would be much better. In general, temperature must be suited to the carbon; therefore, good sense and good judgment are the best guides.

In the construction of springs the manipulating of all plates from one operation to the next must be within the law of steel. A proper furnace is necessary whereby a uniform and correct heat can be obtained before quenching. Proper heat would remove the uneven strains and make a much better spring plate. This would require a little care, a little time and possibly a small increase in cost. However, the result could not be questioned, provided it increased the life of the spring and reduced the number of breaks and kept the engine in service a longer period.

When hardening in oil the oil should be watched, a little fresh oil should be added every day or so, and finally, when the whole mass has become pretty well burned, it should be thrown out, the tank cleaned and filled with fresh oil, as worn out oil loses its power and will not harden plate steel as they should be hardened. Good conduct along these lines will have its telling effect in general.

Frame Making and Repairing.

By George Hutton, N. Y. C. & H. R. R., West Albany, N. Y.

The perfecting of the electric welder with the aid of Blau gas as applied to making welds on broken frames has practically eliminated the necessity of taking frames off the engine, regardless of what is broken; and this work is being done every day, with the minimum of stripping or delaying the other workmen on any other part of the engine.

In our shop, we have not had a broken frame in eight months, and only three in two years off the engine. This is a considerable change in the past two or three years. We attached a great deal of importance to our oil welding of frames, but that is now a practice of the past, as we have not made an oil weld in two years. Our broken frames are all taken care of by electric welder, the preparing of the weld being done by Blau gas, one man doing the whole job. Electric welder and Blau gas are handled by the boiler shop, as they are kept busy principally on boiler work. The details of this method are fully described in last year's proceedings.

A very important feature of frame work, which we will all be called on to give more thought to, is annealing and heat treatment, especially of cast steel and vanadium, and I fully believe that until we heat treat our frames besides annealing them we will always have more or less of the broken frame. Heat treatment, in my opinion, does not apply to vanadium steel only, but to any material of which frames are made. A great deal has been said about annealing frames or forgings and apply them on the engine in that state.

In my opinion, this is only an operation which the forging or casting should go through to make it ready for further perfection, *which is heat treatment.* A new frame which is applied to an engine (annealed only) is in a much weaker condition than when heat treated.

For anyone to convince himself that heat treating is beneficial to any forging, whether steel or iron, try two test pieces, one done in the usual way and one heat treated. Have them pulled and you will get results which will convince you that heat treatment is the proper practice, and the treatment which is good for axles or piston rods can be applied to locomotive frames.

There are several methods and formulas for heat treating, such as quenching in oil bath at different temperatures and boiling water, etc., which method can be acquired by practice and governed by carbon content of steel forgings or quality of wrought iron.

This will seem a rather difficult proposition to many of us here. But sooner or later the difficulty will have to be overcome as a means of securing a more reliable frame. All the methods which have been followed in the past, from the frame made and repaired in the smith shop to the oil, oxyacetylene or Thermit and the more modern electric welds, have not solved the problem of broken frames. All of the welds we are making today may be first-class jobs, but they do not prevent the frame breaking in another part.

Heat treatment has proven to us that the strength of forgings or castings has been increased to nearly double their original strength and I fully believe it would show the same results on frames.

Difficulties of warping will have to be overcome in the same way as they were in getting properly annealed frames. If we go back only a very few years, we all thought it nearly an impossible job to anneal a frame, but today this has been overcome, with properly adapted furnaces, without any warping; and I maintain that heat treatment must follow this operation. There will be little danger of warping or buckling in quenching if we have the means of getting perfect and equal heating.

By C. E. Lewis.

While I believe there is only one way to weld frames right, and that is at the forge, yet, where the conditions are such that the frame cannot be removed from the engine, we will have to use the best judgment that we can. If we consider the cost, I should advise welding with oil, as the oil is much cheaper than Thermit, and the work can be done more quickly. If the frame is properly heated you will have no trouble making it hold. I am not opposed to Thermit and I think it will make a good weld when properly handled. There are a great many places that Thermit can be used on where you could not properly weld with oil. In these cases I think Thermit should be used. I believe that the main point in welding is preheating the frame and here is where

I believe the oil has the advantage over the Thermit. It will take nearly as long to preheat the frame to the proper heat for welding with Thermit as it will to weld with oil; at least this has been my experience.

There is one thing I should advise in all welds, no matter how they are made, and that is that they should be annealed by leaving the furnace on until the frame is cold. This will give better results.

We consider our percentage of welds very good, but I am unable to say that we have none to break. I believe the man who has no breaks doesn't do much welding. One of the main causes of frames breaking is that the pedestal caps are not properly fitted up. One other point is the turntable at the different round houses. If you will notice when the engines are entering on the table, there will often be a drop of as high as three inches. We all know what a strain this is on the frame. I think if these two points were followed up there would soon be less broken frames.

We also have found that after the frame has been broken at one point, a clamp is put on, instead of the frame being welded at once. I believe this is wrong, as it will often cause the frame to break at another point. I believe that many times these clamps are put on without the master mechanic's knowledge and the practice should be broken up.

Oxyacetylene Welding and Cutting.

[A paper on this subject was presented by T. E. Williams, of the Chicago & North-Western, and will be published in a later issue.]

Case Hardening.

By P. T. Lavender, N. & W. Ry., Roanoke, Va.

I will give you as near as I can the method employed at the Roanoke shops of the Norfolk & Western in case hardening. We use a cast-iron box, size 20"x20"x48", and in the bottom of this box we place a layer of burnt bone about 2" thick. We then pack the material to be case hardened in box on top of the layer of burnt bone, each piece being about ¾" apart and especial care being taken that no two pieces touch. In order to be sure that the pieces do not touch we use raw bone, which is packed between each piece. When box is about full we cover the material with a 2" layer of bone, and place lid on box. We have found that by having the lids to our case hardening boxes made of boiler plate that we do not have to use fire clay.

The box is now ready to place in the furnace, which is done by means of an air hoist. We use a semi-muffled furnace, having a perforated arch between the box and the combustion chamber, with flues in wall of furnace opposite burner, that run down to bottom, giving an outlet under bottom of box. By the above arrangement we have found that we are enabled to obtain a uniform heat.

We then heat to about 1450° F and hold this heat as near as possible for about 12 hours. The material is then taken out of box and quenched in a bath of proper size of cold running water.

By following the above treatment we generally get a case hardening of about 1/16" or 3/32".

We use sawed raw bone for this work, and have found that we get better results from raw bone than from anything else, although we have used other case hardening material.

By D. Huskey, Fmn. Blks., C. G. W. R. R., Oelwein, Ia.

For case hardening in our shop, we use a steel box, a layer of charcoal first being placed in the bottom, then a layer consisting of a mixture of cyanide and salt about 1½" deep is solidly packed on top of the layer of charcoal. The pieces to be hardened are then placed on top of this mixture, about ½" apart and covered with a mixture of cyanide and salt. The above described process is repeated until the box has been filled to its capacity. The lid is then placed on the box and it is sealed with fire clay or sand. The box is placed in an oil furnace which is used for this purpose and the heat is brought to a lemon color and maintained at that point from nine to twelve hours. This method had produced good results. As to points of carbon that our case hardening contains, I have no means of telling accurately, as furnace is not equipped with barometer, but have found by putting in test pieces that this method will produce case hardening from 3/32" to 5/64" deep.

Heat Treatment.

By H. E. Gamble, Penn. R. R., Altoona, Pa.

While heat treatment has been applied to almost every part of the automobile with success, it has not been applied to the locomotive until the last few years. The Pennsylvania has carried on quite a little experimental work in this line for the last three or four years, but it was not until January 1, 1913, that they decided to apply heat treatment to their locomotives. They have now at their Juniata shops a complete heat-treating plant for the reciprocating parts of all locomotives, including main rods, side rods,

Fig. 4—Heat Treating Plant at Juniata Shops, P. R. R.

axles, crank pins, piston rods and valve motion parts, as well as a varied line of miscellaneous work. The plant is located in one of the smith shops, and occupies about 60x100 feet of floor space. (See Fig. 4.)

There has been installed a cylindrical oil-fired furnace, 6 ft. diameter inside by 16 ft. 6 in. deep, in conjunction with a quenching tank 14 ft. square and 20 ft. deep, the tank being located to the right of the furnace.

Next to the tank on the right is located a horizontal muffle type furnace, oil fired, with a heating chamber 7 ft. wide, 14 ft. long and 30 in. high, the hearth of this furnace being constructed on a car.

A small horizontal muffle type furnace, oil fired, with heating chamber 4 ft. wide, 7 ft. long, and 12 in. high, is located near at hand, with oil and water tanks conveniently located, for the care of small work. An electric furnace, with heating chamber 8"x8"x18" long, is used for experimental work and calibration of pyrometers. A crane of 12½ tons capacity and a span of 54 ft. was installed for handling the work in and out of furnaces and tanks.

The vertical furnace mentioned above is contained in a concrete-lined pit, about 12 ft. square and 13 ft. deep; one side of the pit being common to the quenching tank. The furnace is supplied by 8 low-pressure oil burners, the flame of which is admitted to the furnace at a tangent to the inside circumference.

The quenching tank is built of concrete, the sides extending above the floor line about 3 ft. It is lined throughout with 4"x8" yellow pine, to protect the sides and bottom from injury. Water is admitted at two points near the bottom through two 4" pipes, and passes off at the top through two 6" pipes.

While we have only had the plant in operation about a year, we have handled quite a lot of steel, including various alloys, such as chrome vanadium, mayari and nickel, also special chrome.

While we have obtained some very fine results on the alloy axles, we are handling mostly carbon steel, which after heat treatment gives us good satisfaction.

Our method of treatment of axles is as follows: Heat in vertical furnace 8 hours after furnace assumes constant temperature; quench in water about 70° F. for 8 minutes; reheat in horizontal furnace for 8 hours after assuming constant temperature; cooled

in the air after being placed on rails in a pyramid, so they will cool slowly.

A physical test is taken of all heat-treated parts. The sample is taken with a hollow drill, which cuts a core ⅞" dia. x 6" long. This work is done on a horizontal boring machine. If the axles pass physical test, they are then put through a drop test, after which they are accepted for service.

Main rods, side rods, piston rods, and all long work is handled in a similar manner. Crank pins, return crank, valve stems, cross-heads, cross-head pins, cross-head keys, etc., are handled in the small horizontal furnace, the method of treatment being practically the same.

We have found heat-treatment a wonderful lot of good also in our miscellaneous work, such as bolt headers, dies, latch blocks, milling machine arbors, hammer rods, and lifting devices.

Following is an outline of our treatment for various parts, as well as for different steels:

Carbon Steel Axles—

Heat 1,550 deg. F.
Quench water at 70 deg. F.
Reheat 1,100 to 1,200 deg. F.
Cool in air.
Physical tests.
Over 50,000 Elastic, 85,000 Ultimate.
20% Elong., 40% red.

Chrome Vanadium Axles—

Heat 1,650 deg. F.
Quench water 70 deg. F.
Reheat 1,100 to 1,200 deg. F.
Cool in air.
Physical tests.
Over 85,000 Elastic, 120,000 Ultimate.
20% Elong., 50% red.

Mayari Axles—

Heat 1,550 deg. F.
Quench water 70 deg. F.
Reheat 1,075 deg. F.
Cool in air.
Physical tests.
Over 70,000 Elastic, 100,000 Ultimate.
20% Elong., 50% red.

Main rods, side rods, piston rods, crank pins, etc., follow practically same treatment, except the length of heat and length of quench.

In connection with our heat-treating work, we have a laboratory, which is equipped for full chemical analysis of all steels; also, a 100,000-lb. tensile machine for the physical tests. This alone is a very important factor in the heat-treating process. There are two things which are necessary to know, if we wish to meet with success in heat-treatment. One is the steel, and the other is the pyrometers.

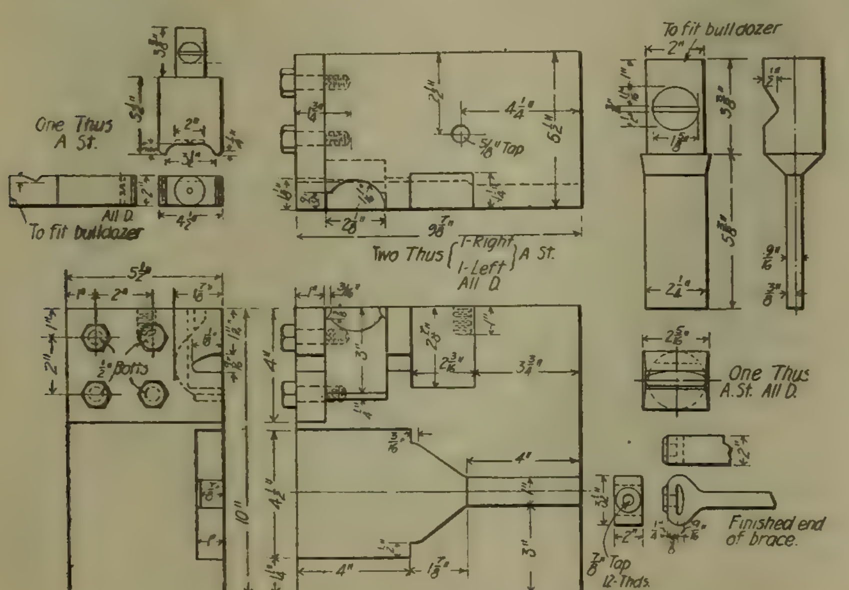


Fig. 5—Dies for Back End of Back Flue Sheet Brace.

Shop Kinks.

By J. W. McDonald, Fmn., P. R. R., Trenton, N. J.

Fig. 5 is a die designed to form back end of back flue sheet brace, as only part of this brace is shown. It may be well to explain that this piece is first roughed out under steam hammer, then taken to machine and upset and punched at the same heat. This makes a very clean piece of work as compared to making by hand. The hole is punched with one blow; by doing this you do not take as much chance to fracture the metal as you would when

Fig. 5A—Finished Brace End.

punching by hand or steam hammer. Fig 5A is the finished product.

The punch die, shown in Fig. 6, was designed to make nut-lock washers for guide-bars and is used on No. 6 Hilles & Jones shears. This is accomplished by removing shear blade heads and inserting a false holder to carry the punch and bottom die. You must make three operations to get the first washer, but after that you get a complete washer with every stroke of the machine until you have

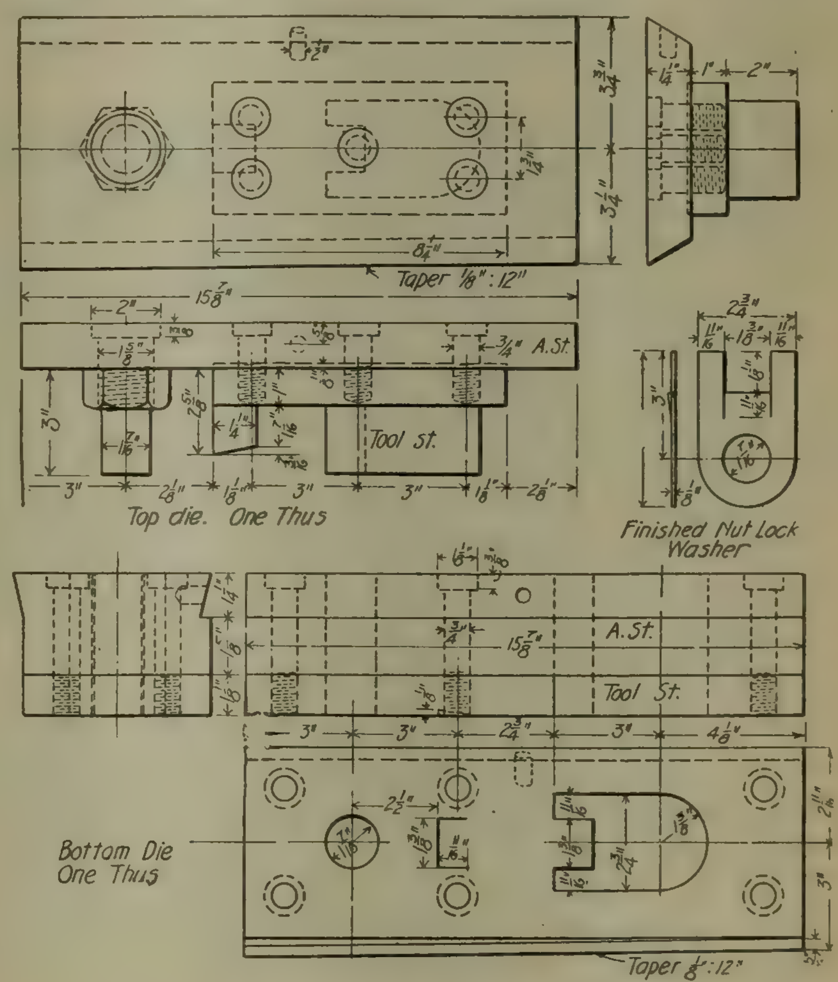


Fig. 6—Dies for Nut Lock-washers.

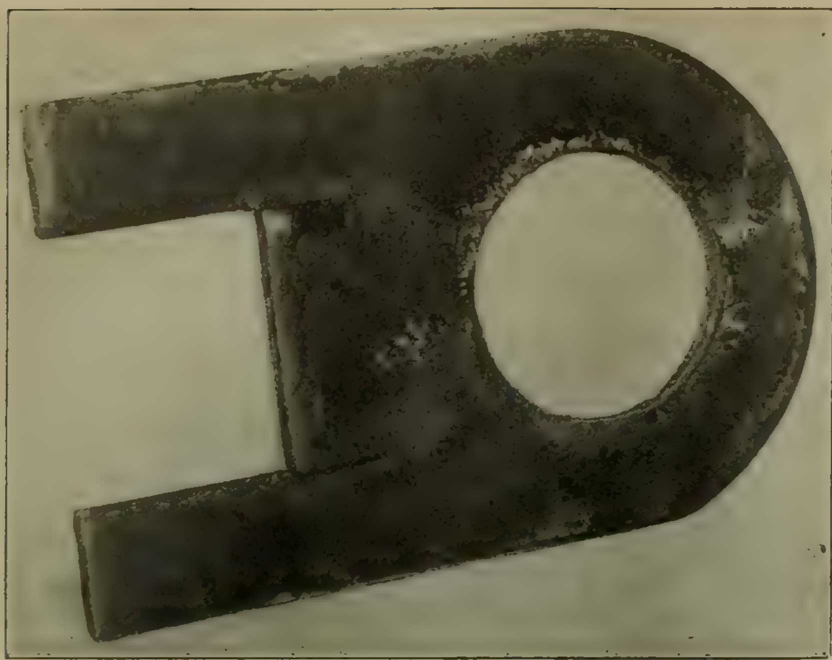


Fig. 6A—Finished Piece After Being Punched.

Fig. 7A—Finished Hangers.

used up the bar of material, then you must start again with three operations. The finisheα piece is shown in Fig. 6A.

Fig. 7 shows dies and method of forging spring hanger used on tender trucks. This same method was followed in the manufacturing of about a thousand of these hangers. On account of not having forging machine large enough to make this hanger, I was

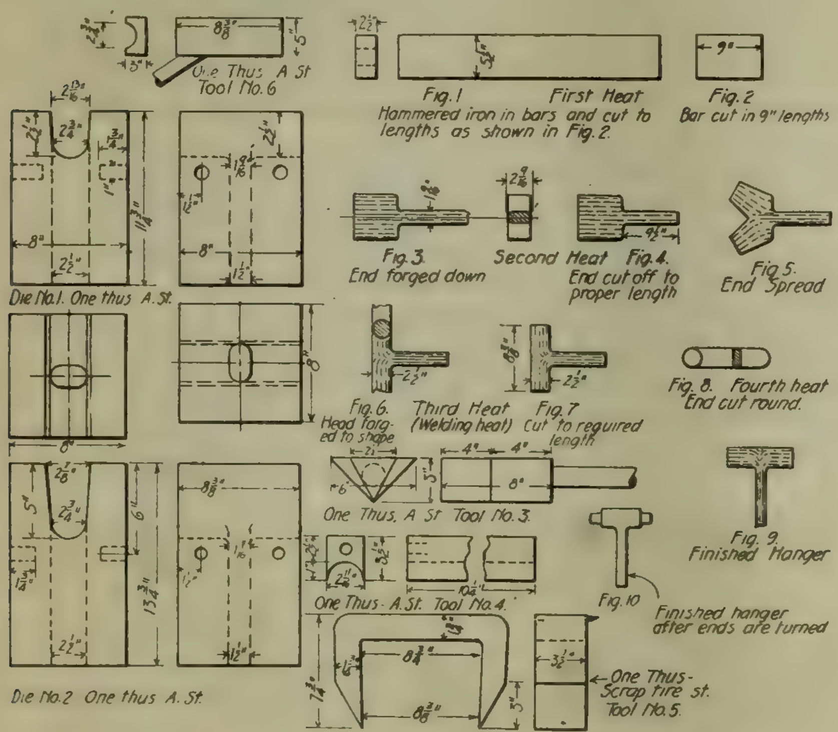


Fig. 7—Dies for Spring Hangers.

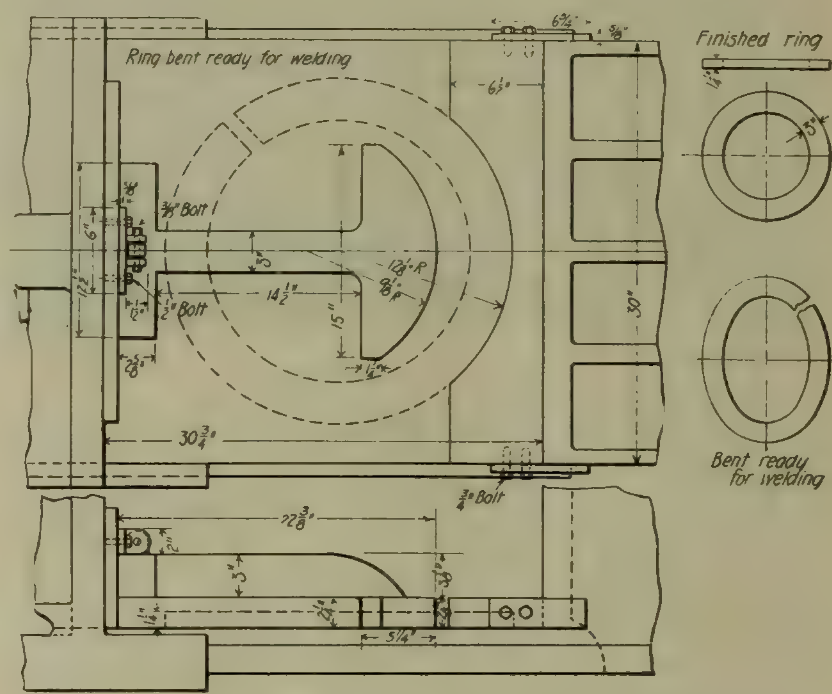


Fig. 8—Dies for Bending Steam Pipe Flanges.

compelled to, make them under steam hammer. Fig. 1, in this illustration, represents stock roughed down to size and cut to length, as shown in Fig. 2. It is then reheated and end reduced, as shown in Fig. 3; the end is then cut to length, as shown in Fig. 4. Forging is then placed in die No. 1, and with tool No. 3, the top is spread so as to start to carry the fibres of iron, as shown in Fig. 5. In the next operation, the iron is reheated to a welding heat, placed in die No. 2, and using tool No. 4, the top end is forged down, as shown in Fig. 6. With the same heat and same die by using tool No. 5, both ends of hanger are cut off at same time to proper length, as shown in Fig. 7. In thé fourth heat the bottom of hanger is cut half round, as shown in Fig. 8 and Fig. 9. This completes the hanger in the rough. Fig. 10 shows finished hanger after ends are turned on machine. Several of these hangers after being completed in the rough were sawed in about six or eight sections, then given an acid test to learn positively if the fibre of the metal had the flown in the proper direction. In all cases it was found that the metal had

Fig. 8A—Ring Bent in Die and Then Welded at Fire.

flown as intended, as indicated by dotted lines, shown in Figs. 7 and 9. The finished hanger is shown in Fig. 7A.

Fig. 8 shows dies for bending steam pipe flange on pneumatic bending machine equipped with 18″ cylinder, 30¾″ stroke, as we are called on very often to make a number of these rings as well as others of various dimensions, including angle iron rings and half rings. With this attachment you can produce work of this kind at a very low cost, as well as reducing the hard labor that is involved in work of this kind, when performing same by hand. The rings shown, like others when removed, are as near perfect as can be made. You will note that the ends of iron do not meet within ¾ of an inch. This allowance is made for scarfing, which is done on one side only. The plunger head is bridged to allow ends of rings to pass under while bending. This head is hinged on the back end to allow same to raise so you can remove ring after bending. The ellipse ring is formed with the same die by using a shoe on face of both formers with corresponding shape of the ring in both dies. When welding either ring, use round iron to fill in scarf. This is accomplished by taking a separate heat on

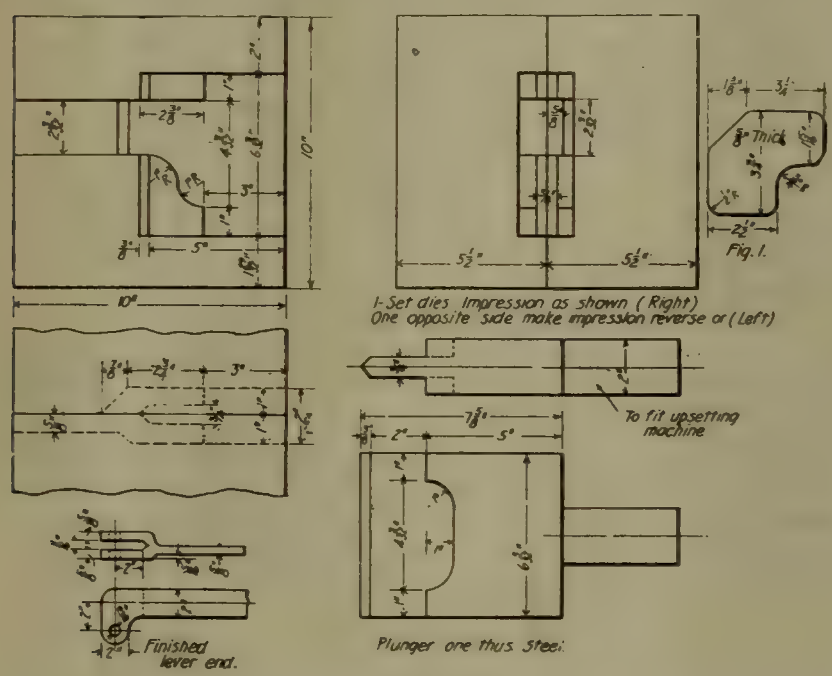


Fig. 9—Dies for Ash Pan Connecting Jaw.

each piece; this completes weld in one heat. The ring is seen in Fig. 8A.

Fig. 9 shows dies for making ash pan connecting jaws. You will note the amount of metal required to make this jaw; same cannot be gathered from a ⅝″x2″ bar. To overcome this difficulty I first punch pieces to shape, as shown in Fig. 1 of this illustration. We then punch a 7/16″ hole on the 1 15/16″ end, and also punch a 7/16″ hole in the straight piece of ⅝x2″ iron, then rivet the three parts together just sufficient to carry to machine, after taking a welding heat. In this way we get a very satisfactory job at a very low cost. You can see at the finished lever end, there was no slotting to be done. Up until the time we designed this die, this piece was forged solid at steam hammer, and the center was

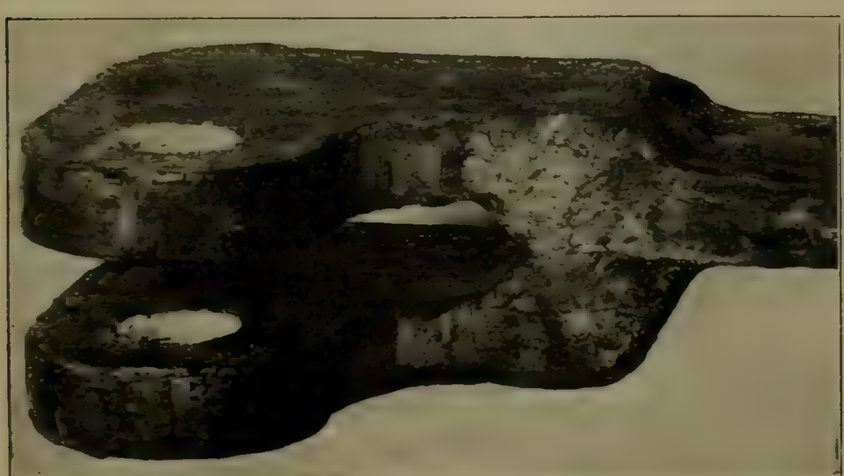


Fig. 9A—Hook-end Jaw Made by Dies in Fig. 9.

slotted out in the machine shop. The cost for slotting exceeded the cost of the complete jaw, as now made in forging machine in smith shop. I just recently completed one hundred of these jaws. The finished jaw is shown in Fig. 9A.

By W. C. Scofield, Ill. Cent. R. R., Chicago, Ill.

The illustrations show some shop kinks of Burnside (Chicago) smith shop. Preparing road tools, as you know, generally means that this is expected to be done while you are resting, as no provision is made for it, and in order to meet the requirements in our shop the following tools were made:

Fig. 10 shows dies for any power hammer for drawing out, cutting off and finishing spike maul in one heat. It is afterwards

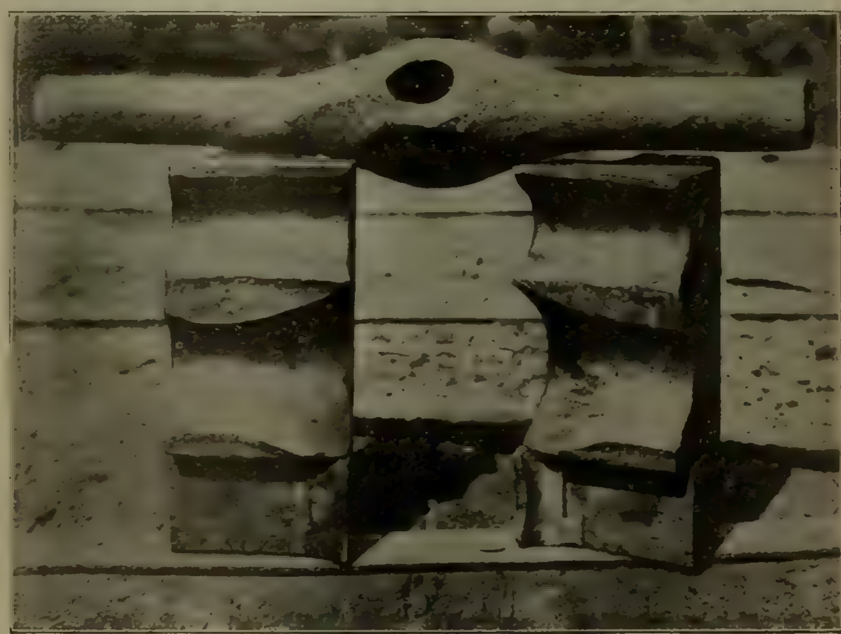


Fig. 10—Dies for Spike Maul.

tempered and ground ready for handle and the output is only dependent on heating capacity and endurance of operator.

Fig. 11 shows dies for dressing track chisels. The first operator draws out the head and cuts off while the second operator changes the cutting off tools in the dies, then draws out the chisel end and cuts off. The cutting off tools are so shaped as to reduce grinding to a minimum. The third operation is the tempering, for which it is best to have a suitable furnace, as it will greatly

Fig. 11—Dies for Track Chisels.

increase the output and make it more uniform. The fourth operation is to grind ready for handle. Output, as before, is dependent on heating capacity and endurance of operator. We also have dies on same lines for steeling clay picks and for flat and cape chisels for machinists, boilermakers and car repairers. The dies are made from scrap driving axles, heat treated and hardened with tool steel inserted cutters. The dies are not expensive to make, are cheaply maintained and with fair operator make a first-class job.

Fig. 12 is steam hammer die for making ends for safety chains for passenger coaches. The forging is first roughed out, before

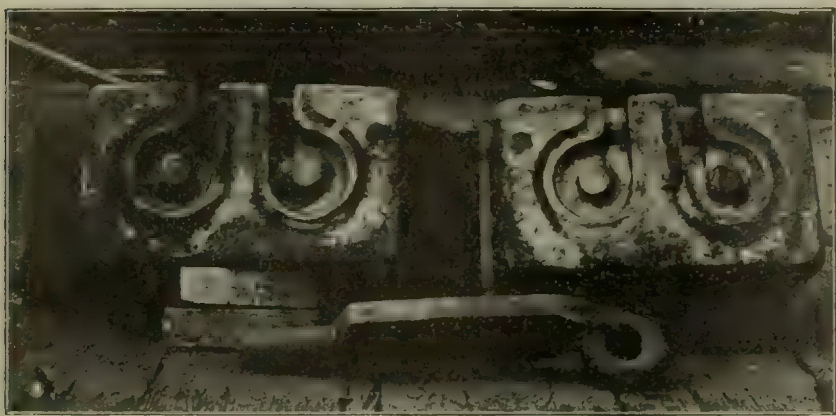


Fig. 12—Dies for Safety Chains.

using the die. There are two impressions in the dies, making it appear as though forgings are right and left, which is not the case, but shape of forging makes it necessary. The heated blank is first placed in one impression and taken out, turned over and placed in the other impression, and as impression in bottom die is one-eighth of an inch deeper than in top, this will trim off flush. This makes a beautiful and first-class forging—it has every appearance of a drop forging.

Fig. 13 shows steam hammer dies for making engine truck

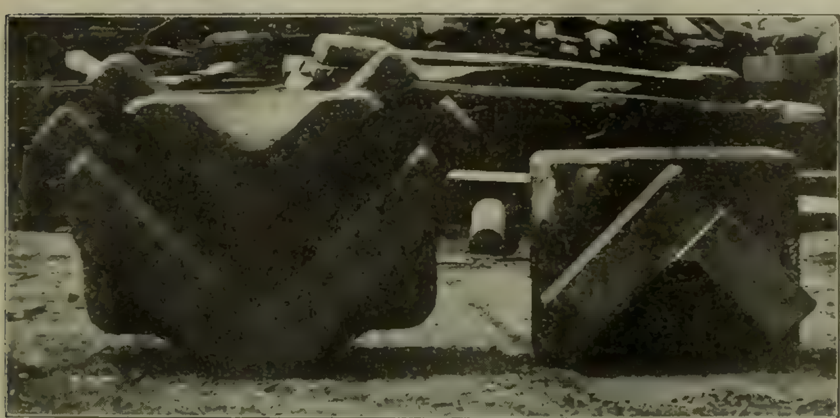


Fig. 13—Dies for Engine Truck Frames.

frames, it being our practice to draw out bars from scrap iron axles. First, the long and short pieces are heated in suitable furnace and put in dies between adjustable stops and welded in dies without any preparation. Then the two halves are clamped together in a jig, heated and welded in corners in same die. In this operation the frame is handled in crane. It certainly makes a good job and when made in any quantity will prove a paying proposition.

Dies for Bolt Header.

By Wm. J. Mayer, M. Blks., M. C. R. R., Detroit, Mich.

We have been trying for a number of years on the Michigan Central to make short bolts with one blow, cutting off at the same time. We did fairly well; however, the bolts were not satisfactory. A one-blow bolt made under the best of conditions is hardly a bolt at all, unless a finn is put on. This necessitates trimming the head, so that with this added operation there is no saving. Being satisfied that we could make a good bolt with two blows it became a question of cutting the short bolts from the bar, thus saving the cutting at the shear.

Fig. 14 shows the header, bolt dies and cutting dies, which solved our problem. The bolt dies are on the bottom and the

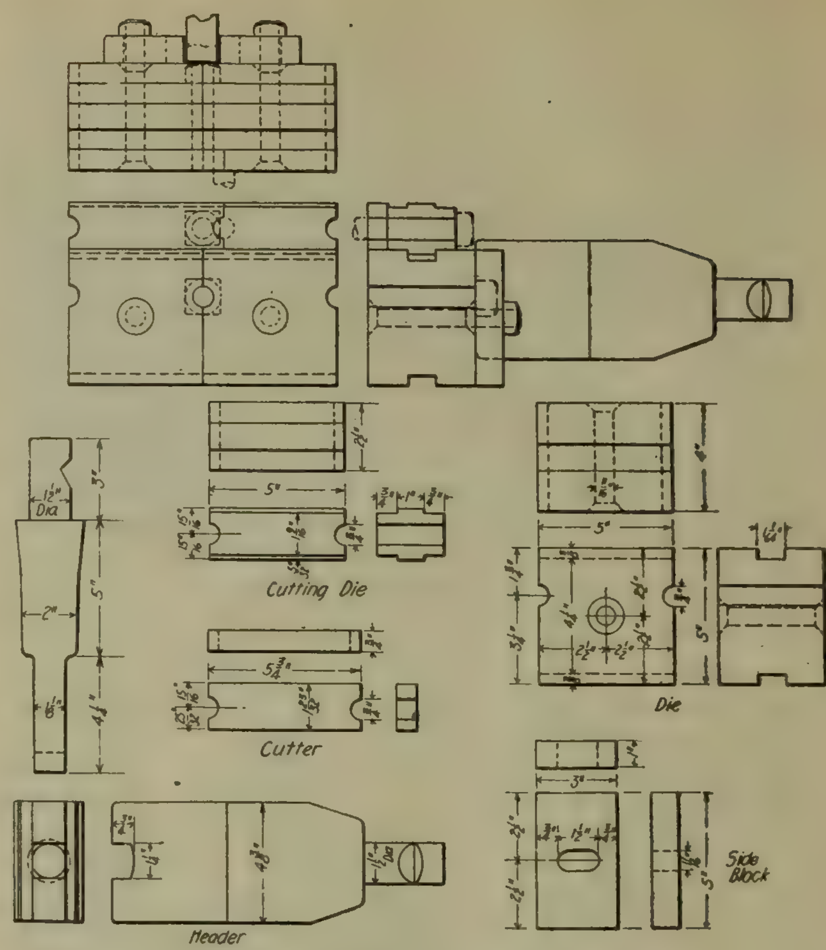


Fig. 14—Details of Bolt Header Dies.

cutting dies fit on top of these, so that the operator need only raise the bar a few inches to cut. It is advisable to have the dies no wider than the shortest bolt to be made, so that no part of the stock required for the next head is gripped in the dies. A gauge is bolted in with the dies so that we can make bolts off the bar up to five inches in length. This means a bolt with a good head cut from the bar with three blows.

ASSOCIATION BUSINESS

The report of the secretary-treasurer showed that the association has 329 members, as follows: Active, 282; associate, 32. and honorary, 9. The report showed that the association had a slight deficit, and therefore it was voted to increase the annual dues from $3 to $4. The following officers were elected for the coming year: President, T. F. Buckley, D. L. & W. R. R., Scranton, Pa.; first vice-president, T. E. Williams, C. & N. W. Ry., Chicago; second vice-president, W. C. Scofield, Ill. Cent. R. R., Chicago; secretary-treasurer, A. L. Woodworth, Lima, O.; chemist, G. H. Williams, Boston, Mass. The city of Philadelphia was selected as the place of the next convention.

RAILWAY MAIL PAY.

Following a meeting of the committee on railway mail pay, held to discuss the report submitted to Congress by the joint congressional committee on railway mail pay, Ralph Peters, chairman of the committee representing 218 principal railroads of the country, authorizes the following statement:

"It is most gratifying that the joint congressional committee fully and unanimously sustains our main contention that the railroads are now materially underpaid for carrying the mails.

"The committee proposes a plan of payment which will give the railroads an increase of $3,000,000 a year, and completely supports the companies in the other leading principles which they have urged, namely:

"That the railroads are entitled to a fair commercial profit for carrying the mails; that apartments in cars fitted up as traveling postoffices should be paid for; that the railroads should be paid for the terminal messenger service they now perform, and that the system of weighing the mails only once in four years is unjust and unbusiness like."

WHO CAUSED THE WRECK.

Contributor.

At the age of twenty I applied at the office of the master mechanic of the railway which ran past father's farm for a position as fireman. It was in the fall, and as the road needed men to handle the heavy traffic, I was immediately taken on without being required to serve the preliminary course in wiping. However, I was, of course, given the usual examination of eyesight and general physical condition.

My first work was the lightest the company had to offer, firing a yard switch engine. With the assistance of the engineer I quickly picked up the knack of handling the fire and "keeping her hot." And it is possible that I showed more than the usual aptitude, for I was selected within a few weeks to go out on the road in pusher service on one of the heaviest locomotives in the district. This engine was perfectly capable of consuming 7,000 pounds of coal per hour, but, luckily for me, we rarely worked more than thirty minutes on a train in assisting it up a heavy grade, after which we would drift back.

After the fall rush of freight had fallen off I was given a regular run in freight service and was fast learning the tricks and arts of my selected trade. I had joined the brotherhood and was learning to rely on its power to keep my job for me in spite of occasional fractures of the rules of the company.

Thanks to the "pooling system," I rarely had the same engine twice in succession, and some of the power we got was not in the best condition. If we could finish a run with a leaky engine we were not much concerned about its repair, because we counted on some other poor devil getting her the next trip out. In the days when individual engines were allotted the crews I was told by the older men that it was customary to remain with the engine in the roundhouse until repairs were made. In modern times, however, we got away from the job as soon as we had signed the arrival book.

One day I was marked up to take out an engine which proved to be in a very leaky condition. The engineer trusted me with tending water, and as it was almost impossible to keep steam on the heavy grades, I would shut off the "gun" until we were over. This practice was all right if the grade was not too long. On the day in question we were struggling up the longest grade on the division and had pitched over the crest when I discovered that the water had gone so low that with the change in the level of the track it disappeared from the gauges. We were carrying a heavy fire and before I could bring the water up we had burned the crown sheet. It burst downward with terrific force. I landed back in the tender on the coal, but the engineer was scalded to death. He died without making a statement and the blame was fixed upon him.

After coming out of the company hospital I was placed on call in passenger service and found the runs much easier on account of the short duration.

A book could be written of my experiences of a year in this service; but it will suffice to say that I learned that in case of accident the proper course was to blame the equipment when anything went wrong. One of the engineers whom I fired for, in particular, was a veritable wizard in avoiding blame for infractions of the rules, whether serious or not. I learned also that there was a tendency to make light of infractions of well-needed rules, provided the crew could get away with it.

We had a speed limit of sixty miles per hour, but delays are, of course, unavoidable, and the crew which brought the train in on time in spite of delay was not watched too closely with respect to speed.

After three years, another fall's heavy traffic was instrumental in my promotion to locomotive engineer. I then joined the engineer's brotherhood at a time when a strike was threatened in a wage dispute. The difference was settled on our road by a new agreement which was very favorable to the men. One of the conditions was a strict adherence to the seniority list in promotions in service. This made it impossible for the road to select its men for picked runs.

The effect was bad. I, for instance, knew that if I merely stayed with the job my chance of promotion did not depend upon special effort, but would be secured for me in my turn. I did as little as I could and grew into habits of dissipation, managing to stay just within the bounds of absolute requirements.

I had been in freight service only a short time when heavy demand for men drew the seniority list down to me and I went into passenger service. As I look at it now, I did not have much of an appreciation of greater responsibility in my new position at the head of a passenger train. I was given to reckless running to make up lost time and was only mildly censured for it. At one time I "ran" a signal set against me and was caught, but as no accident resulted, I was given only a few days' vacation without pay.

On the night previous to the accident which I am about to describe I had been out with a party of friends on an excursion which brought us home in the early morning. I arrived at my boarding house just in time to receive the call boy, who told me I was marked up to take out the second section of Number 3, the fastest train on the road. Without notifying the trainmaster or roundhouse foreman of my condition, I took the big new Pacific at the turntable and without bothering to closely inspect her, I prepared to leave the yard.

Our traveling engineer, George Howard, came over to the engine and appeared surprised to see me in the engineer's seat. He said: "Frank, is this your run today?" I replied that it was.

"Well, look over that machine carefully; Wesley had trouble with the air pump yesterday. We don't want it to cause you trouble today."

I was not disturbed by the news, although I had heard of Wesley's difficulty. I was too tired to move about much and it was only a few minutes until I had my train and was waiting for the first section to clear the terminal yards.

As I got the signal "out of town" after the usual test of brakes, the semaphores in the yards were clearing, one after the other behind first Number 3. As second 3 we ran on the block of the first section for several miles, when I got a delay at an interlocking crossing. If there had been any trouble with the brakes I could not find it, for our stops were as smooth and accurate as usual, and I got away after the crossing delay with the idea of making up the lost time.

As we spun along at better than seventy miles per hour, I got dozy and actually could not keep my eyes open. The fireman, however, called the signals regularly and nothing went wrong until we neared a station which was not a regular stop.

The approach to this station was a long downgrade with a curve at the bottom. A distance or caution signal was located half way down the grade and at the entrance to the curve was located the home signal. Without closing the throttle, I allowed the engine to tear down the grade at better than eighty miles per hour.

The distance signal must have been against us, but the fireman was busy at the time with the injector, which he was tending. He, however, yelled to me that the home signal was at danger when we were very close to it. This had the effect of waking me from my doze, but I was not fully aware of the situation.

I made a heavy service application of the brakes and then released and threw her into emergency as I saw the rear end of first 3 standing in front of the little station. I started to pull over the reverse lever. But in my haste I forgot to shut off steam and therefore could not move it. We struck with terrible force. The rear car of the first section was well filled and we tore clear through it. In the cab I scarcely noticed the impact, but it seemed as if the engine would never stop.

Then came the inquest and investigation. My schooling had taught me that I must blame the equipment and I recalled the traveling engineer's caution and saw salvation. His caution was only an ordinary one, but the brotherhood lawyer hired to defend me made it look black for the road. I had been forced to take out a defective engine when it was known to be such. I had tried to reverse and the lever was "too stiff" to move. I remarked

in confidence to the lawyer that it was a good thing that I didn't reverse, for, on top of the emergency brake application, reversing of the engine would not have assisted but would have retarded the stop.

Thirty-two people were dead, and I was exonerated by the jury, which expressed pretty accurately the opinion of the public.

I expect to return to service as soon as I recover from the effects of the shock. In the meantime I am living at the company's expense. Thanks to our agreement, I shall be given the best train, as I top the seniority list.

NONCONNAH TERMINAL, ILLINOIS CENTRAL R. R.

The Illinois Central has completed and put into operation a new terminal at Nonconnah, Memphis, Tenn., which represents the latest practice in locomotive and car repair plants.

The roundhouse is built in the form of a semi-circle, lacking about 35 degrees. It is composed of concrete pilasters with brick between and a wooden interior framing. The roof, which is laid with composition roofing, is constructed in two longitudinal sections with reversed pitches, the narrower one of small radius being eight feet lower than the other. It slopes down to the top of the stalls, of which there are twenty. In the strip of wall between the sections of the roof, louvre boards and windows admit fresh air and light. The entrance doors to each stall have the upper halves composed of glass, giving plenty of light; in fact, 34.5 per cent of the combined door area is of glass. One wall of the roundhouse serves as a fire wall in case of further extensions at the eastern end. There is one fire wall now which divides the roundhouse into two equal parts. The doorway in this wall as well as the one communicating with the machine shop are provided with steel doors of fireproof design.

Roundhouse and Machine Shop at Left, Offices and Storeroom in Center and Powerhouse at Right.

An innovation in heating of roundhouses is presented in the use of cast iron radiators in the engine pit and on the outer circle wall pilasters. Each pit has 432 square feet of radiating surface and the total for the house including wall radiation is 11,313 square feet. Each pilaster has 135 sq. ft. of radiation. Exhaust steam from the power house is used in heating.

The hoods for the cast iron smoke jacks are fitted with drain pipes jutting well out on each side from the gutter around the bottom and serve to carry away the corrosive drippings. The blow-off, filling and washout pipe lines run overhead through the triangular openings in the upright beams supporting the overhead frame work, and are suspended by hangers of rod and angle iron construction. From these lines at every other stall branch pipes run down the columns to within about 4' 6" of the ground. Each end of these pipe lines is fitted with a patent valve. The alternate columns carry the steam and air lines arranged in like manner. All the air lines are fitted with a standard cock and Bowes patent air hose connections thus insuring airtight joints so essential to perfect working condition. All these mains with the exception of the blowoff line are conducted (entering at the west end) through a concrete line tunnel below the surface to the washout system installed in the power house. The blowoff line is elevated about 20 feet, being supported by hollow posts with built-up wrought iron supports on top.

Machine Shop Looking East.

The roundhouse is lighted with high intensity Tungsten lamps, three of 250 c. p. being placed between each engine pit. This gives an excellent light for night work. These are supplemented by Westinghouse receptacles for extension cord plugs located on the columns between pits. The drop pits contain Watson-Stillman jacks with an 8-ft. lift. Overhead on a runway a 6-ton air hoist takes care of the handling of heavy parts.

The roundhouse is served by an 85-ft. turntable of modern design operated by a Nichols electric tractor designed to turn the whole table through one revolution under load in one minute. An inspection pocket is provided in the wall of the pit for oiling and inspecting the tractor.

MACHINE, BOILER AND SMITHSHOP.

These facilities are contained in a fireproof building 149 feet long by 68 feet wide, constructed with brick walls, concrete roof and steel window sash. At the end next to the roundhouse is an office and tool room, while on the opposite side there are combined toilet and locker rooms with an apartment for air brake repairs, etc. The work benches are arranged in a continuous line against the northwest and south walls except for gaps to permit of passage through doorways. This shop is magnificently lighted, the lighting surface being approximately 50 per cent of the total wall area. The machine and tool equipment is very complete, all tools being individually motor driven, consisting of the following:

Prentice 24" engine lathe.
Lodge & Shipley 42" engine lathe.
Lodge & Shipley 16" engine lathe.
Gould & Eberhardt 24" crank shaper.
Aurora 36" drill press.
Acme 1½" doublehead bolt cutter.
Oser 4" pipe threading and cutting machine.
Planer converted to motor drive.
Forty-two-inch grindstone.
Two grinding wheels.

The boiler shop is equipped with a Lenox throatless rotary shear which has a capacity up to ⅜" plate. Located in the smith and pipe shop are two concrete forges equipped with individual one-horsepower motor blowers.

All the motors used in the shops are operated on a 3-phase, 60-cycle, 440-volt alternating circuit current.

Exhaust steam is used for heating in connection with cast iron wall radiation. The total radiating surface in this shop is 3,254 square feet.

OTHER BUILDINGS IN LOCOMOTIVE GROUP.

The roundhouse office is a brick structure of about 27 feet by 99 feet and consists of the office, engineers' register room, locker rooms, lavatories, storeroom and oil house. The upper story of the building contains a lavatory, rest room and locker room for the use of trainmen. Three hundred well ventilated steel clothing lockers manufactured by the Durand Steel Locker Co. are provided in the locker room, adjacent to which is the lavatory containing shower baths and other first class toilet facilities.

The storeroom is a splendid example of up-to-date storehouse layout, every facility for the efficient storing of material having been considered. Adjacent to, and part of the storeroom, is the oil room. This room can be entirely isolated from the storehouse proper by means of steel fire doors. This room possesses unique features in the apparatus for handling oil; three centrifugal motor-driven pumps are installed for tank and barrel fittings. Separate tanks are provided for storing the following kinds and quantities of oil:

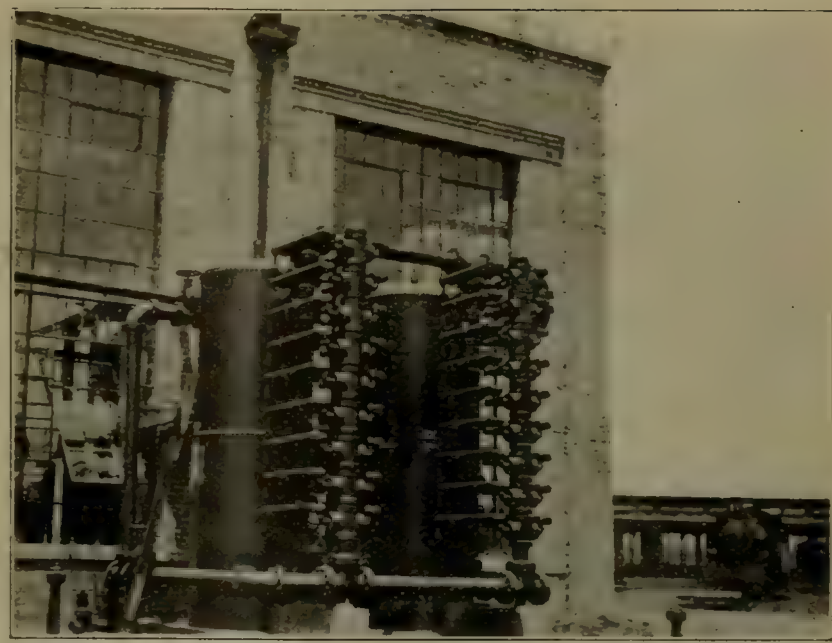
Fuel, 12,000 gallons.
Signal, 1,200 gallons.
Superheat valve, 1,600 gallons.
Valve, 1,600 gallons.
Mineral seal, 500 gallons.
Black, 3,500 gallons.
Kerosene, 3,500 gallons.
Car, 3,500 gallons.

Hand pumps of the self-measuring type are used for handling these oils. A pump of this design for fuel oil is also located in the roundhouse, thus doing away with the necessity of frequent trips to the storeroom. The pipe being laid in the tunnel alongside the steam pipe, no difficulty is experienced in pumping during severe weather. Adjacent to the oil room is a waste storage space of sufficient size to carry a thirty days' supply. The entire oil house equipment was installed by S. F. Bowser & Co. and represents this company's latest efforts in modern oil house equipment. This building is lighted by Tungsten 220-volt lamps with the exception of the oil room where the Tungsten lamps are incased in vapor proof globes and receptacles. On the platform outside and surrounding this building on three sides are located racks for the storage of castings and springs.

A—Planing Mill. B—Wheel Shop. C—Paint Shop. D—Toilet. E—Scrap Platform.

POWER PLANT.

This building, which is of fireproof construction, is 40 feet by 110 feet, with 25 per cent of its wall area in glass, thus affording splendid lighting facilities. It has a transverse wall in the middle to separate the boiler room from the air compressor room. A reinforced concrete chimney 156 feet high is located on the south side of the boiler room. For a height of 55 feet it contains a double wall, thus forming a chimney within a chimney. The remainder is single walled. The inner wall is built of radial fire brick which at the base are 7½ feet from the outer wall. This affords a cylindrical wall of air, which confined between the two provides effective insulation. Connected with the chimney by a breeching of rectangular cross section are three 150-horsepower boilers measuring 72 feet by 18 feet equipped with Burke's patent smokeless furnaces. These furnaces project out about six feet in front of the boilers and are fed through rectangular openings in their arched roofs. The coal supply is stored in long concrete bunkers or bins, openings in the wall of which provide the fireman with the means of obtaining the necessary supply of coal. There are also contained in the boiler room three pumps and a Blake-Knowles 800-horsepower open-feed water heater. Adjacent to the boiler room are located two Laidlaw-Dunn-Gordon air compressors of a capacity of 1,200 cubic feet of free air per minute. Special attention has been given to the handling of compressed air, thermometers being applied to the first stage discharge and the second stage intake and discharge of the compressors for observation at all times of the temperature of the air. A cast iron after-cooler of unique design is placed south of the power house in connection with the air reservoirs, to effect a separation of contained moisture and reduce the temperature of the air. This is one of the few applications of cast iron for air cooling in this country. In the same building and occupying the eastern end is a boiler washout system designed and erected by the National Boiler Washing Co.



After-Cooler at Southern End of Powerhouse.

The coal chute, which was designed and installed by Roberts & Schaefer, Chicago, is a creosoted structure 84 feet 6 inches high. Its bunkers, two in number, have a capacity of 500 tons. The whole structure rests on a double row of stout piles over the coal car storage track. Underneath with its top even with the earth is a concrete pit which has a capacity of 50 tons of coal. The skip and counterweight are operated by means of an electric-driven winch on the ground floor. This winch consists of a grooved drum 28 inches in diameter geared to a 15-horsepower General Electric induction motor through two pairs of steel cut gears. The inside pair are ordinary spur gears while the outside, which turn at a higher speed, are Falk herringbone type. The results anticipated in using gears of this type are noiseless running and less wear and tear on the working parts. The motor is operated by a special Cutler hammer automatic skip hoist controller. On the controller panel are mounted four double-pole magnetic switches with blow-outs. Two of these are used to form a combined main line switch and reversing element while the other two in connection with series relays are used for acceleration. There is also located on this panel a tryout switch and time limit relay adjusted for a period of ten seconds.

INSPECTION AND CINDER PITS.

An inspection pit is provided on the incoming engine track near the coal chute, with a shelter for the engine inspector. The idea is to develop the use of the inspection as much as possible during as many minor repairs here as possible instead of at the roundhouse.

There are three single engine pits from which the cinders are removed by a Browning locomotive crane using a clam shell bucket.

Adjacent to the inspection pit is a building for the storage of tools used by the enginemen. Scoops, picks, oil cans, lanterns, etc., are cared for in this building in a systematic manner, the equipment being gathered, cleaned, filled and cared for by an attendant, thus relieving the enginemen of the necessity of obtaining their own supplies.

WATER SUPPLY.

Water for use in the locomotive, drinking and toilet purposes is obtained from three wells 400 feet deep. A pump of 300,000 gallons capacity is located just east of the power house, adjacent to a small building in which are housed two Fairbanks-Morse pumps.

The mechanical details were handled by the office of the mechanical engineer under the supervision of R. W. Bell, general superintendent of motive power.

TELEPHONE SERVICE.

The operating head of a large coal-handling organization recently said:

''Careful observation has convinced us that we can increase the efficiency of our telephone service greatly by impressing upon our employees whose duty it is to meet our customers and the public through the agency of the telephone that courtesy is the basic principle of a successful telephone conversation and that the success of our business depends in a great measure upon their ability to create a favorable impression over the wire. So important do we consider this branch of our business that we make a careful study of the telephone characteristics and qualifications of our people. When we find an irritable, nervous temperament that 'goes up in the air' when using the telephone, his work is so arranged that he will receive the minimum number of calls and the men with the equable dispositions, those not easily ruffled, who have agreeable voices and pleasant manners of speech, are entrusted with our telephone trade. A large part of our business is transacted over the telephone and I cannot take any chances with a hasty-tempered man at 'this way in.' ''

This statement emphasizes the importance of vigilance on the part of business managers in seeing that the relations of their houses with the public are not impaired through careless or indifferent use of the telephone.

The age in which we live is one of many inventions. These inventions in the main have for their aim the facilitation of business in the saving of time, the corollary of which is the saving of money. No modern device has done so much to expedite the handling of everyday transactions in the commercial world as the telephone. It has become such a common factor in the business equation that its use is looked upon as a matter of fact, as commonplace. And therein lies the danger—we are likely to become careless in the use of it.

No mechanical contrivance can of itself render a complete service, the human element has its important part to play and it is regrettably true that every human element often renders impotent a perfect mechanism. Of none of the thousand and one accessories that have been devised and applied to business uses can this be said with greater truth than of the telephone. Its proper use can make it the most useful, dependable and profitable adjunct to an organization, while its abuse can transform it into a menace to the success of an undertaking. It is simplicity itself to make it the former; one does not have to be a technician, a mechanician or an electrician to operate it, nor an expert in any line save that of courtesy and self-control.

The manager quoted at the outset of this article laid down a few precepts that are instilled into the minds of his force and which may be applied in every business house: The telephone must be answered promptly, with clear enunciation in a cordial tone. The name of the company and the name of the person speaking are given immediately upon taking the receiver from the hook. If the person is not the one the calling party wishes to talk with, he says, ''One moment, please, I will have you transferred,'' or, ''Mr. Blank is out just now, can I be of service?'' or, ''Can I have him call you?'' When a dissatisfied or ill-humored customer gets on the line the instructions are imperative that, under no circumstances must the employee lose his self-control, no matter what the provocation; he can only return ''the soft answer'' in a dignified and courteous manner. Employees are taught that they are the house to the party calling; that an irate customer is not offering them a personal affront but is scolding the house, hence they must adopt the policy of the house, which is to mollify the disgruntled one and hold his business rather than be over-sensitive and, by a hasty rejoinder, soothe the pride but lose a patron. Experience has shown this manager at least that an angry call can in almost every instance be transformed into a reasonable, conciliatory conversation by the use of a few well-phrased sentences uttered in a quiet, courteous manner.

Great importance attaches to tonal effects in telephone conversations. Sharp, imperative tones should not be used, they startle and irritate with their abruptness, particularly when they convey such queries as ''Who do you want?'' ''Who are you?'' ''You got the wrong number,'' ''This ain't Blank 90000'' and so forth. Equally as offensive is a drawling, indifferent ''Hello'' or indistinct mumbling of the name of the house. Instead, there should be a clear, distinct response in an obliging tone indicating a sense of pleasure for having been called and a desire and readiness to serve.

The head of one large house makes it a business to call in to his place of business not infrequently, in order that he may know how his telephone calls are answered, and woe to the employee who answers improperly.

It cannot be gainsaid that courtesy plays an all-important part in telephone practice, and after all, telephone courtesy is, in the final analysis, just plain, practical business sense applied simply, easily and gracefully over the wire.

FIRST RAILWAY POSTOFFICE.

August 28, 1914, was the fiftieth anniversary of the date upon which the first railway postoffice was established in the United States. It ran between Chicago and Clinton, Ia., in a crudely equipped compartment car on the Chicago & North Western Railway.

George B. Armstrong was the founder of the railway mail service in the United States. The idea of distributing the mail while in transit to expedite delivery, practically abolishing what was then known as distributing postoffices, was his conception.

To the Chicago & North Western belongs the credit of supplying the first opportunity for the practical exemplification of Mr. Armstrong's idea of establishing the railway mail service, the first complete postoffice car being built by that company from plans furnished by Mr. Armstrong, then assistant postmaster, Chicago, in May, 1867, and was placed in service on the Chicago & North-Western between Boone, Ia., and Council Bluffs, Ia. The advantages of this new system were immediately apparent and it was quickly installed on a number of other large railway systems.—*Passenger Department Bulletin, C. & N. W. Ry.*

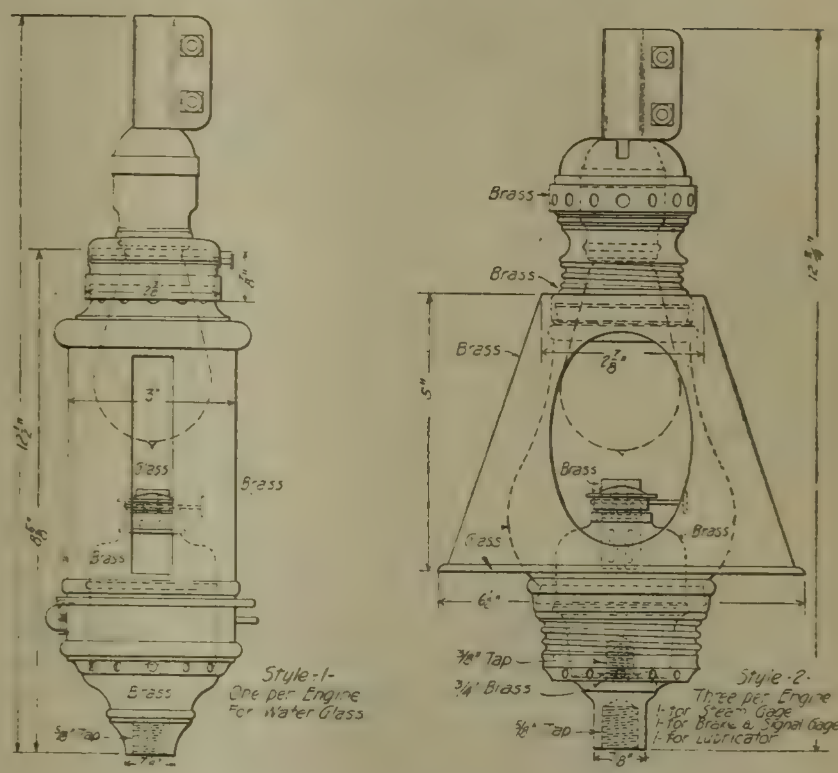
The Southern has given a contract to the Consolidated Engineering Co., Calvert building, Baltimore, Md., for a roundhouse at Forrest yards, Buntyn, near Memphis, Tenn., at an estimated cost of $60,000.

Headlight Standardization, C. N. R.

The installation of electric wiring on locomotive equipment so that it might be properly and effectively maintained in service has been carefully worked out by the mechanical department of the Canadian Northern Railway. This road has finally standardized its electric headlight equipment after about eighteen months of actual experimental work, together with observations of systems in use on many roads. The arrangements adopted are shown in the illustrations.

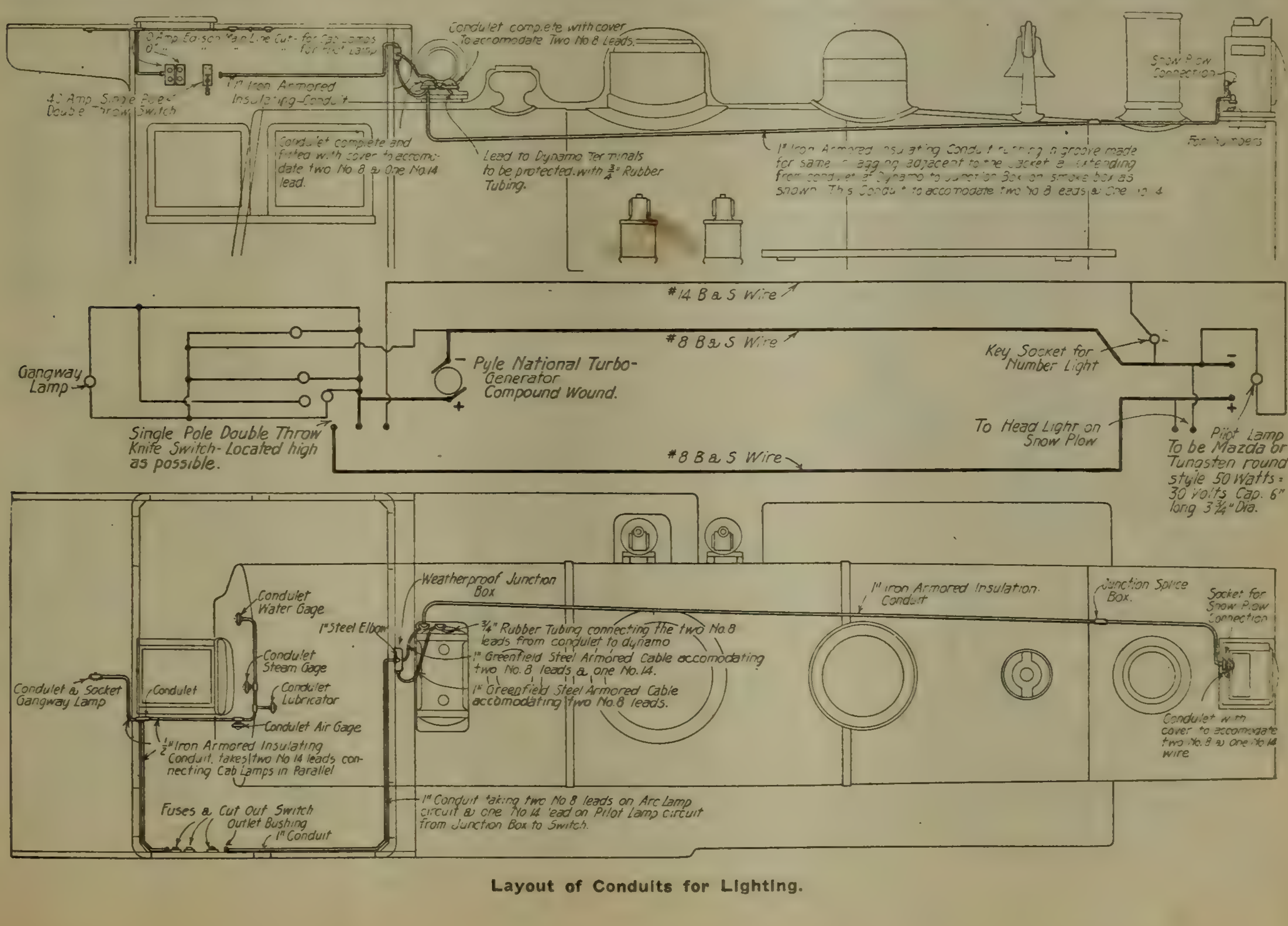
The lighting outfit used is the Pyle-National, type E, the generator being located immediately in front of the cab and crosswise of the boiler. A two inch exhaust pipe is bent at an angle of 45°, being just long enough to clear the roof of the cab. The generator shelf is a piece of white oak, 17"x18". The steam pipe is of copper, drains towards the boiler, and there are no gaskets, only ball or taper joint unions being used. The drain from the turbine is a ⅜" pipe, which extends below the running board and terminates close to, but not within, the draft opening of the ash pan.

The wiring arrangement is shown in the sketch. The main leads and arc lamp circuits are of No. 8 B. & S. slow burning, weatherproof, triple-braid, black wire. All other wiring is made with No. 14 wire of the same type. The wires to the cab and deck lamps are protected by 10 ampere fuses and blocks. The leads from the generator pass through a triple to double plug cut-out and are protected by two 40 ampere, 250 volt, refillable cartridges. The arc lamp lead is tapped for the pilot lamp at a point just within the case and is not inserted in the binding post with the arc lead. All wire splices, socket and receptacle screws, wire connections in sockets and to switch terminal posts are soldered. Armored wire enters sockets through a standard pipe bushing to which it is soldered in order to avoid loosening the socket connections.

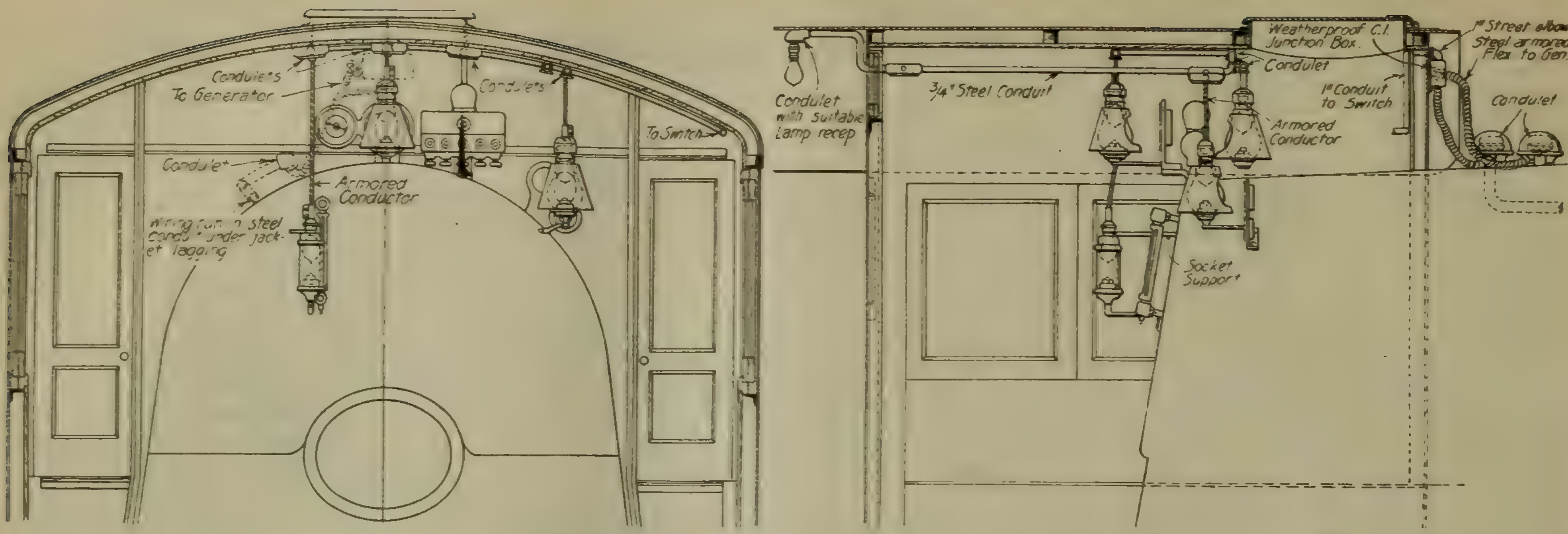


Standard Cab Lights, C. N. R.

Wires from the hood to generator are protected by a suitable length of rubber tubing. Above the engineman's seat and just over the window casing is placed a 40 ampere, single-pole, double-throw knife switch which operates vertically. When in the down position it throws in the arc and when in the upper position throws on the pilot lamp. All the wiring in the cab and outside is placed in an armored insulating conduit, with the exception of the sec-



Layout of Conduits for Lighting.



Locomotive Cab Wiring, Showing Location of Lights.

tions between the dynamo and junction box on front face of the cab. These are in flexible steel armored conduits. All fittings are of the standard market type and sockets are of the Edison keyless type with a brass shell. Greenfield armored wire is used to connect overhead leads with gauge lamps and Crouse-Hinds condulets are used throughout. In order to prevent condensation in the conduit piping the three wires were braided and made just small enough to pass through and fill the conduit snugly, thus excluding as much air as possible.

The lamps are of a very serviceable design, combining an oil well auxiliary with the regular electric bulb. The lamp socket was probably the hardest item to secure and it had to be made especially for the Canadian Northern. The mechanical department thought it well worth the extra expense, however, as there is no possibility of the socket becoming disengaged from the armored cable. The water gauge lamp has a narrow rectangular opening and is secured to the boiler face plate by brackets. The lamps for the steam gauge, air gauge and lubricator are somewhat different from the water gauge lamp, as the illustration shows.

The headlight case is equipped with an auxiliary reflector for an incandescent lamp as shown. For a long time the incandescent lamp was placed at the top of the case but it was found that it jarred loose and also that the excessive heat in this location injured the wiring. The headlight shelf is of No. 10 plate, 20"x27", and is provided with a hand hold on the left side. The case is made of No. 20 pickled, cold rolled and reannealed open hearth steel, weighs 80 pounds and has a glass 18" in diameter. The base of the case is of No. 14 B. W. G. steel with sides bent at two angles, doing away with riveting on angle irons. The reflector is of cold rolled copper, triple plated with silver and the box stand supporting it can be raised or lowered so as to change the focus of the reflector as desired. Allowance is made for expansion of the glass as it becomes heated. A feature of the side and front number glass is the device for holding the glass so that it can be removed from the outside.

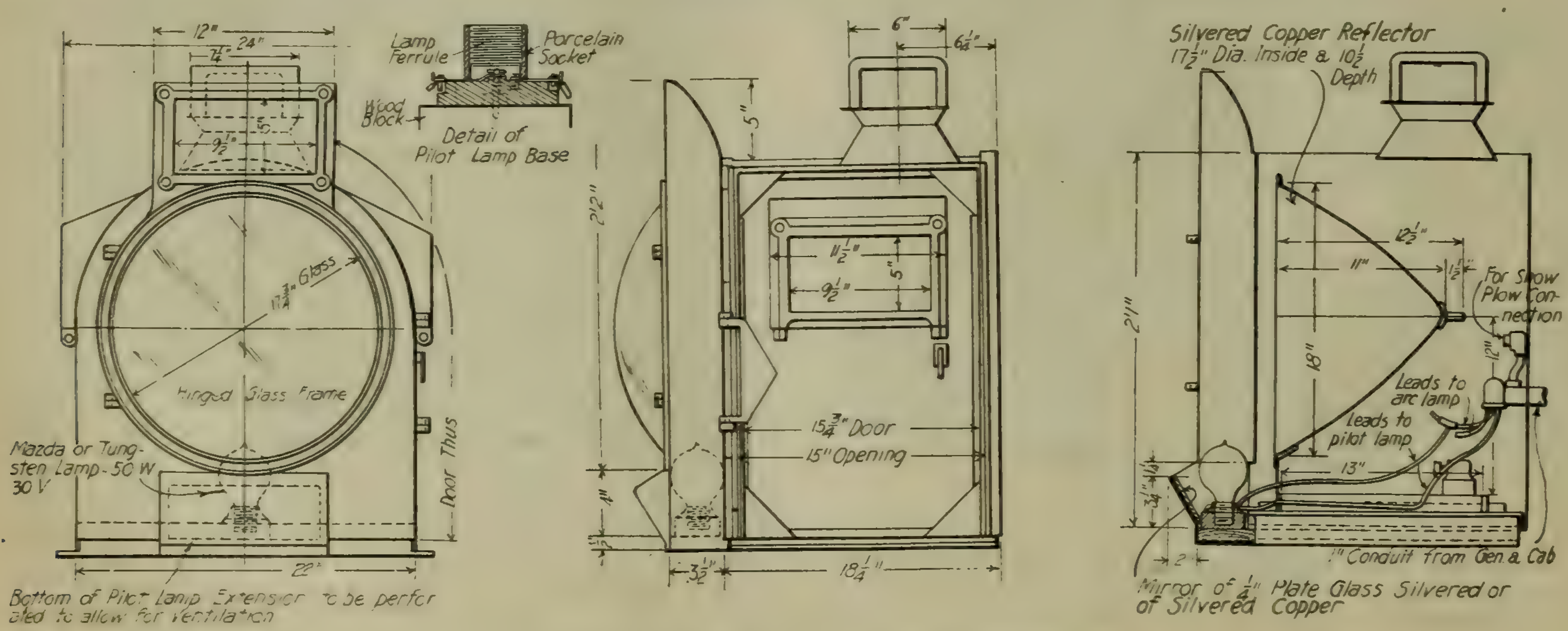
Six steps are provided for each engine, two at either side of the generator, one at the left side of the headlamp and one at the front of the headlamp.

An interesting feature is the plug socket, provided near the headlamp. Snow-plow connectors are provided on all engines and they are found very serviceable for many special purposes, as furnishing connection leads to lamp clusters for auxiliary outfits or in making an inspection of the engine in the yard at night.

The New Orleans, Mobile & Chicago has secured all of the right of way necessary for the construction of the proposed extension from Beaumont, Miss., to New Orleans, La., it is said. The new line will cross the main line of the Gulf & Ship Island near Wiggins and will connect with the main line of the Louisville & Nashville near the Louisiana line east of Pearl river.

Boxley, Haley & Co., of Roanoke, Va., have awarded contract amounting to about $125,000 for two bridges over Tug river and 2 miles railroad up Blackberry Creek, for Norfolk & Western.

The Oregon Eastern branch of the Idaho divsion of the Oregon Short Line has been extended from Juntura, Ore., to Riverside, 19 miles.



Standard Electric Headlight Case, Canadian Northern Ry.

BOILER FEED WATERS.*

By W. A. Converse, Secretary, Dearborn Chemical Co.

We will first consider water as we obtain it from its natural sources, and then take up some of the more important ill effects arising from its use, the theories that have been advanced for the cause thereof, and some of the investigations that have followed.

Water to the technical man is water in an absolutely pure state, devoid of all foreign substances, either gaseous, liquid or solid. Chemically, water is made up of two gases, hydrogen and oxygen. Hydrogen gas, when pure, is odorless, colorless, tasteless and non-poisonous. It has, however, the property of inflammability. Oxygen gas has identically the same properties as hydrogen, with one exception, i. e., it is entirely devoid of the property of inflammability. It will not burn, but it is absolutely essential to all processes of combustion. If it were not for this fact and the fact that a large part of the atmosphere which you allow to pass into the furnaces under your boilers is made up of oxygen, you would not be able to obtain any efficiency therefrom, because there would be absolutely no combustion of the fuel.

It is believed that water as it leaves the clouds is in a practically pure condition, and that the first opportunities for its contamination arise immediately following the beginning of its descent to the surface of the earth. In falling through the atmosphere, either as rain or otherwise, it takes up certain substances. Naturally these substances taken up are dependent upon the substances contained in the atmosphere through which it falls, which in turn are to a large extent due to the industrial conditions existing upon the surface of the earth. But there is one substance always present in the air, and that is carbon dioxide (CO_2) or carbonic acid gas. You, as men interested in the production of power from the combustion of coal, realize that CO_2 is the constituent of your flue gases or your stack gases upon which you base your opinion of the accuracy or the perfection of the combustion going on in your furnaces.

Assuming now that the water has passed down through the atmosphere and has reached the immediate surface of the earth, it has taken up some carbon dioxide (CO_2), some ammonia, undoubtedly some sulphur gases, and probably some oxygen (since the air is made up, to the extent of 20 per cent, of this gas)—all of these gases being in solution in the water itself.

What happens at the immediate surface of the earth? That depends upon the litter or refuse which covers the surface of the earth upon which the water falls. If the surface is strewn with decaying or rotting vegetable matter, such as timber, leaves, twigs, etc., it takes up another portion of carbon dioxide (CO_2), because the process of rotting of timber, for instance, is nothing more nor less than a slow process of combustion; that is, a combining of the oxygen of the atmosphere with the carbon of the fuel which you are burning, or the carbon forming the greater part of the vegetable matter which is in process of decay. If the water falls upon a surface strewn with animal matter like we have in the stockyards district in Chicago, where there is more or less animal matter which is converted into ammonia compounds, it takes up more ammonia at this point. Then, again, animal fats like tallow and lard are made up in part of fatty acids, and these fatty acids are rather soluble in water, and are readily taken up in moderate quantities by water coming in contact with them, and are extremely destructive to metallic surfaces.

If we now follow this water down through the channels of the earth, whether or not perpendicularly through what we call veins, from whence it is later obtained through wells or springs, or whether it travels through channels corresponding to our rivers and creeks, another class of substances is taken up. You noticed that the bulk of the substances taken up previous to this were gaseous in form. Some solid matter is, however, usually taken up at the surface of the earth, but it usually consists of organic substances, which we will not discuss in detail at this time.

If we were to pass distilled water down through a layer of limestone, we would find that it would not take up or dissolve a quantity exceeding 3½ grains per U. S. gallon. But upon analysis of waters that come to our laboratories from time to time we find quantities up to as high as 53½ grains. This means that 50 grains of the carbonate of lime in solution in this gallon of water is there simply because of the presence of carbon dioxide (CO_2) which had been previously taken up from the atmosphere or from the immediate surface of the earth, due to the decay of vegetable matter or otherwise, since 50 grains of carbonate of lime in such water is held in solution by the carbon dioxide gas present. And this particular gas being very readily eliminated from water with a rise in temperature, the carbonate of lime must go out of solution when the water is heated. Water even at 140 degrees Fahr. will give up a considerable portion of this carbon dioxide (CO_2), and if maintained at 212 degrees Fahr. for a sufficient length of time will give up all its free and loosely combined carbonic acid gas, which would result in throwing out of solution these 50 grains of carbonate of lime, leaving in solution the 3½ grains only. I make this point here to show you why it is that carbonate of lime goes out so readily in ordinary open heaters, for instance, or in any appliance where water is heated even to a moderate temperature. Water from wells will often show deposition of carbonate of lime in a glass, if the glass is filled with the water and allowed to stand at ordinary temperature for a short time.

Following the travel of the water through the underlying strata of the earth, we find that it takes up many other and different substances, mostly solid and mineral in character. If the water in traveling down through the earth comes in contact first with a deposit of carbonate of lime, commonly known as limestone, it will take up or dissolve a quantity of carbonate of lime, the amount which it will take up above 3½ grains per U. S. gallon being dependent upon the amount of carbon dioxide the water has previously accumulated in passing through the air and over the immediate surface of the earth, and the length of time the water remains in contact with the limestone. If in traveling through the earth it comes in contact with a deposit of sulphate of lime, or what we know in its natural state as gypsum, we would naturally expect that the sulphate of lime or gypsum would be the predominating substance in the water. That is true in a sense. It is not necessarily true, however, because of this fact: if the water had previously come in contact with a deposit of carbonate of soda (soda ash) it would not dissolve or take into solution any appreciable amount of sulphate of lime. On the other hand, if it had come in contact with a deposit of salt (chloride of soda) before passing through the deposit of sulphate of lime (gypsum), it would take up a very much larger amount of sulphate of lime than otherwise would be the case. You will see from this that the amount of the different solid substances a water may contain is to a considerable extent, at least, dependent upon the kinds and quantities of other substances previously taken up and present in the water at the time of its coming in contact with another substance.

In order to best arrive at the causes of the ill effects of some waters, it may be further advisable to consider some of the substances found generally in ordinary boiler-feed and natural waters. I have prepared and here present a chart which shows the substances usually found. I am barring from consideration at present suspended matter and some substances which may be considered later, if necessary. This chart, on the next page, shows all the substances which are found in practically all waters, those containing other substances being by far the exception:

*Extracts from a paper read before the Railway Club of Pittsburgh.

TOTAL DISSOLVED SOLIDS	Incrusting or Scale forming solids	Silica Carbonate of Iron Alumina Carbonate of Lime Sulphate of Lime Carbonate of Magnesia Sulphate of Magnesia In presence with excess of Carbonate of Lime
	Non-Incrusting or Corrosive or Foaming Solids	Sulphate of Soda Chloride of Soda (Salt) Carbonate of Soda Chloride of Lime Chloride of Magnesia

I desire to call your attention to a few of these. Silica is nothing more nor less than ordinary white sea sand. If we analyze nice white sand we will find that upwards of 99 per cent of it is silica. Silica constitutes the base of our glassware, all of the enamels on our bath tubs, and all that class of material. Passing down to carbonate of lime, school crayon is the most common or ordinary form of this substance; all it contains other than carbonate of lime is a little binder to hold it together, and an abrasive substance like pumice stone to make it work satisfactorily for the purpose for which it is intended.

Next we have sulphate of lime, well known to you as plaster of paris. In its native condition it is known as gypsum. Sulphate of magnesia is an interesting salt from more viewpoints than one. It is one of the things considered by some of us as mighty nice for use "the next morning after the night before," about two tablespoonfuls in a half-glass of hot water before breakfast. It is commonly known as Epsom salts, Chloride of soda (common table salt) is absolutely essential in the scheme of human economy.

The next substance is sulphate of soda. Sulphate of soda is simply a combination of metallic sodium and sulphuric acid. The sulphuric acid is also a very obnoxious material of itself, and since a solution of it will dissolve iron readily, it is extremely objectionable when present in a boiler feed water.

You will notice that the substances on the chart are divided into two classes; incrusting or scale-forming solids, and non-incrusting or corrosive and foaming solids. This means that all those substances shown under the former classification can and do enter into scale formation, these substances being the silica, carbonates of lime and magnesia, sulphate of lime and sulphate of magnesia in the presence of an excess of carbonate of lime. Those coming under the latter classification, due to their extreme solubility, cannot and do not enter into scale formation; namely, sulphate of soda (Glauber's salts), chloride of soda (common salt), and carbonate of soda (soda ash). On the other hand, however, when present in a water in relatively large quantities, they do give rise to foaming, corrosion and many other types of troubles.

The most rational way of explaining the causes of some of the more common ill effects of boiler feed waters would be to consider the analyses of waters from several different localities, representing different types, which have been used in practice a sufficient length of time to enable us to know absolutely the effects of those water, wherein nothing whatever was used to counteract or change their ill effects. In referring to these analyses, I will cite the effects of the different waters, the theories that have been advanced to account for them, and the investigations that have been made to confirm or refute them.

Following is analysis No. 1:

	Grains Per Gallon
Silica	.502
Oxides of Iron and Alumina	.093
Carbonate of Lime (Chalk)	.234
Sulphate of Lime (Gypsum)	None
Carbonate of Magnesia	.407
Chloride of Soda (Common Salt)	3.600
Sulphate of Soda (Glauber's Salts)	8.214
Carbonate of Soda (Soda Ash)	22.789
Undetermined Matter	.180
Total	36.019

The substances named in this analysis are so arranged that those shown below the horizontal line never enter into scale formation, and those above do enter into scale formation, when present in sufficient quantity or relatively large proportions. Those below give rise to troubles of their own kind, more particularly foaming, corrosion, etc. I have selected waters rather heavily impregnated with substances, for the reason that you can more easily interpret quantities in whole numbers than in decimals.

Now what is to be expected of this water in the way of ill effects? It will foam, as we know from experience with water of like kind. Why does it foam? You will notice that the larger portion of the non-scale-forming solids consists of carbonate of soda (soda ash). Carbonate of soda is nothing more nor less than soda ash. We find in the literature of today statements to the effect that a water devoid of suspended matter will not foam. Here is a water that does foam, and as far as the suspended matter is concerned, it contains none. Neither does it contain a sufficient amount of any substances that, when submitted to the conditions extant in the interior of a steam boiler, would give rise to any appreciable amount of suspended matter during an ordinary run between washouts. We do, however, find a total of about 73 grains of the soda salts. They are soluble to the extent of several hundred grains per gallon, consequently they soon reach a point where they induce foaming, due to the fact that they change or increase the surface tension of the water in the boiler itself. You may say that a little matter of 22.78 grains of carbonate of soda is not much. It does not appear to be. But consider a stationary boiler developing 500 horsepower continuously for 24 hours a day; it would evaporate about 45,000 gallons of water. The 22.78 grains per gallon is equivalent to 3.25 pounds per thousand gallons, therefore we would have 146¼ pounds of carbonate of soda in the boiler at the end of 24 hours. Imagine you are operating the boiler but fourteen days or two weeks; you would have 2,047½ pounds in a boiler probably containing a quantity of water equivalent to about 3,500 gallons. So you see you have a very concentrated solution remaining in the boiler, which would foam without question, and it did so foam the second day in service following washout, at which time there was in the boiler not to exceed 130 pounds of the carbonate of soda.

Then another very deleterious condition arose here, viz., the disintegration and softening of gaskets, which in turn resulted in a leaky condition. The gaskets upon the market today are largely made up either of asbestos or asbestos composition, or rubber or rubber composition. Asbestos is a mineral product, and chemists know that it is soluble to a considerable extent in a strong alkaline solution, that is, a solution of some of the soda salts. Asbestos as it exists in gaskets is in a very fine, fibrous condition, consequently when this strong alkaline solution comes in contact with it, the alkali naturally dissolves these fibers and causes a breaking down or change in the properties of the gasket itself, resulting in trouble. These are chemical facts and can be confirmed by experiment; consequently, are we not safe in assuming that it is due to the carbonate of soda, which is the only alkali contained in the boiler?

Now what about the effect, if any, upon the gaskets of the rubber type? If you will take an ordinary rubber band and place it in a strong boiling solution of carbonate of soda, or caustic soda, and allow it to remain there for say 48 hours, you will find that the rubber band has changed very materially in character. It has its elasticity, it has swelled to several times

its original size in diameter, and it has become of the appearance of cold glue or gelatin. If it can be shown that these substances in this solution alone will do these things, why should we not attribute these ill effects to the said substances contained in the water, where it predominates to the extent it does here? The correctness of our theory is also absolutely confirmed in practice, as we find that in no case do we experience these troubles where a water is used containing practically the same amounts of the substances shown in the chart under consideration, other than the soda salts.

The next analysis shows a very interesting problem brought to the attention of the writer several years since:

	Grains Per Gallon
Silica	1.576
Oxides of Iron and Alumina	.280
Carbonate of Lime (Chalk)	Trace
Sulphate of Lime (Gypsum)	44.989
Carbonate of Magnesia	11.339
Sulphate of Soda	2.404
Chloride of Soda (Common Salt)	4.590
Undetermined Matter	.096
Total	65.274

First let me call your attention to the fact that about 58 grains out of 65 are made up of scale-forming salts, and about 45 out of the 58 are sulphate of lime. Naturally we would expect this water to give rise to the formation of a large amount of scale, and it did. Furthermore, we would expect the scale to be made up of sulphate of lime to a very large extent, which was also true, as shown by analysis. Now the peculiar trouble in this case was serious corrosion underneath the scale. It is not uncommon for some to assume that if we have the surface of a boiler covered over with scale, corrosion would be practically impossible. In stationary practice it is a common expression that we would rather have $\frac{1}{32}$ inch of scale over the interior of the boiler than to take the chances of corrosion. This position must of necessity be considered erroneous. Upon a thorough investigation it was found that corrosion actually did take place, and to a very serious extent, and this condition gave rise to a greater anxiety than the scale formation itself.

Upon a careful analysis of a portion of the scale lying next to the metal, which was apparently originally a part of the surface of the metal, it was found that there was an action going on which compared identically with the action of sulphuric acid upon iron, because sulphate of iron was found on analysis of the substance taken off of both the surface of the tube and the side of the scale which was originally in contact with the tube. The water itself was not acid, contained no free sulphuric acid, and consequently must be a liberated product. The theory advanced as a result of the investigation thus far carried on was that the sulphate of lime constituting the greater part of the scale lying in direct contact with the metal did reach a temperature, when the scale had become of sufficient thickness, which caused a decomposition of the sulphate of lime, liberating sulphuric acid. This sulphuric acid in turn attacked the metallic iron, giving rise to corrosion. The sulphate of iron formed as the result of the corrosion, being an extremely unstable salt, that is, one that does not stay together very readily, breaks down in the presence of temperature and moisture, and again liberates sulphuric acid, leaving behind the iron in the form of iron oxide. The sulphuric acid again acts upon the metallic iron, producing more sulphate of iron, which is in turn converted into oxide of iron.

You might ask why the sulphuric acid leaves the oxide of iron to go to the metallic iron. In chemistry every individual substance has an affinity, and the metallic iron has a greater affinity for the sulphuric acid than does the oxide of iron which it left, consequently we have the formation of a new portion of sulphate of iron. This is what the chemist would term a cyclic or continuous action, that is, the acid liberated from the scale, acting on the metallic iron, decomposing, acting again and again on the iron, and resulting in corrosion. How did we proceed to prove that this theory was correct? In order to bring about decomposition we know that it was necessary to have temperature, because we know that sulphate of lime does not decompose below a certain temperature; so that with the use of mechanical devices the scale formation in this boiler in which the experiment was carried on was turbined down to one-half its original thickness, and it was found that as long as the scale was kept down to one-half the thickness which it ordinarily formed in a given length of time, no corrosion underneath the scale formation took place. Isn't that sufficiently strong evidence that the cause of the trouble was first due to a liberation of sulphuric acid, in turn due to the high temperature governing at the point of contact of the scale with the surface of the metal, which primarily was due to the thickness of the scale? Therefore, with the prevention of scale formation to a great extent, we keep the temperature down at the point of contact, and obviate the liberation of sulphuric acid, and consequently eliminate the corrosion in this case. The correctness of the foregoing conclusions was confirmed by following out such procedure in practice.

Following is analysis No. 3:

	Grains Per Gallon
Silica	.595
Oxides of Iron and Alumina	.116
Carbonate of Lime (Chalk)	8.783
Carbonate of Magnesia	4.569
Sulphate of Soda	1.836
Chloride of Soda (Common Salt)	3.040
Undetermined Matter	.088
Total	19.027

In this water we have an illustration of the correctness of the statement made, that foaming can be due to suspended matter. I do not mean now that it is always attributable to that, as waters absolutely devoid of suspended matter, containing other substances, do foam without question. In this case we have a water that contains 19 grains of solid matter, of which all but about 5 grains are what could be classed as scale-forming substances. As a matter of fact, this water does not under many conditions give rise to more than a small amount of scale formation. The carbonates of lime and magnesia when precipitated from a water of this type go out of solution in a very finely divided, oozy, or what might be termed a gelatinous condition, in which form they are not to a very great extent retained in a heater, but pass therefrom to the boiler in the form of suspended matter, where, due to their light gravity, they travel very readily with the circulating water. The small particles of these incrusting substances soon begin to generate steam from their own surfaces, which results in the body of water in the boiler assuming the condition of a seething mass, which finally results in a foaming condition. In other waters containing these same substances in virtually the same quantities, and also containing even a moderate amount of sulphate of lime, foaming is not usually experienced, owing, no doubt, to the fact that the sulphate of lime when thrown out of solution is much heavier than the carbonate of lime, and readily settles upon the interior surfaces of the boiler, and in so doing carries with it mechanically a considerable part of the precipitated carbonates, the mixture readily attaching itself to the surface of the boiler in the form of incrustation.

An experiment was carried on for the purpose of determining whether or not the foaming experienced in this case was correctly attributable to the precipitated carbonates, as follows: The feed water was treated in such a manner as to remove about one-half of the carbonates of lime and magnesia shown by analysis No. 3, and then pumped into the boiler, and it was

found that it was possible to operate the boilers over a period of sixty days, with no trouble in the form of foaming. Further experiment developed the fact that the same results could be obtained by changing the carbonates into other substances by chemical reactions, and at a much lower cost.

There is another condition that arises from the use of waters of this kind. Since the carbonate of lime is thrown out of solution in a very finely divided and light condition, and gives rise to trouble in the form of foaming and priming, we may correctly assume that the steam space in these boilers is full of these floating particles, in which condition they would naturally carry over with the steam. It is commonplace in districts where waters of this kind are used to have complaints to the effect that it becomes necessary to open up the cylinders of the engines every so often, in order to remove more or less of a black, putty-like substance. Upon analysis of many samples, we found that this so-called putty-like substance was nothing but a mixture of cylinder oil and carbonates of lime and magnesia, principally the former. We know that the oil itself carries none of these substances, consequently there is no other possible way of its coming into the cylinders except that it be carried over mechanically with the steam, and that is just what happens. Even though there is no foaming or priming, the finely-divided carbonates of lime and magnesia carry over and are constantly rubbed together with the cylinder or valve oil, and produce this putty. This trouble was overcome also by changing the nature of the precipitated substances by chemical reaction.

Why does not corrosion take place uniformly over the entire surface, rather than in the form of pitting? Because the composition of iron or steel is not continuous or uniform. No doubt many of you at least have had the opportunity to look over a chemist's report covering a sample of iron or steel; in case you have you must have noticed that he did not state the amount of iron it contained, but he did tell you that it contained carbon, silicon, manganese, sulphur, phosphorus, etc. Each and every one of these substances, as they exist in the metal of the sheets or tubes, are chemically combined with a certain amount of the pure metallic iron or other metals, forming new substances characteristic of themselves, which are very different from the pure or uncombined iron itself. The balance of the metal is made up of uncombined iron, commonly known as ferrite. Since, then, the sheets or tubes are not of continuous uniform composition, and knowing that practically no two different substances are soluble to the same extent, we can assume that the compounds of iron which were the most soluble in the water in contact with their surface would first of all dissolve to the greatest extent, which would result in the corrosion showing in the form of pitting rather than taking place to a uniform extent over the entire surface.

There have been three principal theories advanced governing the corrosion of iron and steel during the past several years, generally referred to as the electrolytic or galvanic, the carbonic acid, and the peroxide theory. Since, however, the electrolytic theory has virtually displaced the other two, it is the only one which we will consider at this time.

Science tells us that every substance in existence is either electro-negative or electro-positive to every other substance. We also know that it is not uncommon in boiler practice to have present a noticeable galvanic current, which, if this theory is correct, must result in corrosion. There are three essentials to a galvanic cell, viz., an electro-positive, an electro-negative substance or pole, and an electrolyte or carrier. Referring to the non-continuity of iron or steel, we have, even in a small area of sheet or flue, the necessary different substances to act as the two poles, and the presence of a layer of water over the surface will act as a carrier. Therefore we have the necessary elements for corrosion. If the water carries more or less common salt, or some other substances, the current-carrying capacity of the water is enhanced and the tendency to corrosion relatively increased.

We must not for a moment lose sight of the fact that with a properly equipped locomotive the boilers are directly connected with brass fittings, copper ferrules and at times other metallic accessories, to say nothing of the difference in the character of many flues, or the flues and shell, or both, all of which tend to corrosion in some form or another. We may have either wrought-iron or steel flues or tubes in a boiler, which may be absolutely as good as it is possible to produce, but sufficiently different in their composition or continuity, or both, to bring about a possible condition leading up to electrolysis.

Since, as previously stated, there are three essentials to an electrolytic action, it stands to reason that if we can eliminate one of these the trouble would be overcome. It is not, however, possible for us to prevent two substances acting in the capacity of the two poles of a battery, under favorable conditions, but it is possible to so change the water being used as a feed supply as to destroy its ability to act as an electrolyte, and thereby prevent corrosion.

[Mr. Converse exhibited several slides illustrative of the electrolytic theory of corrosion.]

REPAIRING BOILER TUBES

By A. N. Lucas, Gen'l Fmn. Blr. Wrk., C., M. & St. P. Ry.

The subject of repairing locomotive boiler tubes while out of boiler is an old one and has been brought out at different times. Still I find there are a number of roads that do not appear to make use of the best practice in caring for flues and preparing same ready to go back in the boiler.

It has been the practice of the Chicago, Milwaukee & St. Paul for a number of years, when tubes are taken out of a boiler, to rattle same carefully; that is, not to rattle them any longer than necessary. One or two hours should be ample, but many times flues are placed in the rattler and allowed to hammer themselves to pieces four or five hours and sometimes longer, and when they are removed from the rattler they are shown to be highly polished and in many cases cracked and badly split. This is due to the poor judgment in rattling flues.

When flues are taken from the rattler we make a careful inspection for pitting and light weight. If any show indication of being light, flues are weighed up on scale that we have for that purpose near flue rattler. Two-inch flues weighing less than 1⅝ pounds to the foot are not put back in a locomotive boiler. Two and one-fourth inch flues weighing less than 2 pounds to the foot are not put back in a locomotive boiler. The best of these flues are assorted and used in stationary or pump boilers.

Our next operation it to cut the flue to length for welding. This is an extra operation due to the fact that we weld on both ends of our flues alternately, and to avoid having a weld come too close to the front flue sheet, which might bother when rolling same, we find it absolutely necessary to cut flue to length for welding.

We cut our steel flues up in pieces 5 inches to 7 inches, 8 inches or 9 inches, as the requirements may be, for welding on or safe ending. These pieces are cut off on a machine we have for that purpose, which cuts off the piece, bevels and removes the burr at the outer end in one and the same operation.

We believe in taking the burr off of the inside of the safe-end piece at the firebox end. This so that flue will pass over flue mandrel on welding machine readily. By removing this burr it also allows us to use a larger mandrel on flue welding machine. This helps us to keep the flue the original size.

Many roads do not take time to remove this burr or use the larger mandrel, but their flue shows to be contracted at each weld. We are using for a 2-inch flue a 1$\frac{11}{16}$-inch mandrel, which is about the original inside diameter of flue.

After the flue is cut to length we heat and open up all flues at front end to fit flue hole in front flue sheet. This to avoid shimming, which takes time and is poor practice.

Many roads are still welding on but one end of the flue, in some cases as many as five and six welds, and every weld on a flue is one more chance for a failure.

Many times flues are slightly overheated at weld and become

quite thin just back of the weld. Leaks do develop at these points and flues do break in two at these welds, sometimes in the rattler and other times while in service. So I say the less welds you have on a flue the better.

A flue with five or six welds at one end might weigh up all right, but the old part or the original would not be good for further service.

As I stated before, our practice is to weld on both ends of the flue alternately, and flue put in service today with safe end at firebox end. This flue may run from two to three years, and when removed the bead is cut off at firebox end, and at the front end with flue cutter about 1½ inch from end of flue.

Now before welding this flue we cut to length for welding and apply the safe end piece on the opposite end of flue. Then when flue is welded we cut to proper length to go in the boiler, but only have to cut 1 inch or 1½ inches off of the original safe end.

This flue again goes into service for another two or three years, and when flues are taken out bead is cut off at firebox end and at front end with flue cutter as before, is then cleaned and cut for welding. This time we cut the original weld off and the new piece or safe end is again welded on the front end, which leaves the flue with but two welds, and this operation continues throughout the life of the flue. It always gives us a good new safe end at firebox, the old safe end at front flue sheet.

By following this method we don't know what it is to split a flue in the front end or to damage a flue in the rattler and we have a better flue at all times than where safe end has been repeatedly welded on one end.

A great many might object to the cutting of this flue for welding, but unless you do this you cannot tell where the old weld will come at the front flue sheet.

The cost for cutting flues to length for welding is less than ½ cent per flue, or about 50 cents per 100. I believe if this practice was carried out you would have a flue that is worth that much more to you at all times.

It has been computed that the average railway journey in the United States is thirty-four miles in length; and based on the number of fatal accidents, it is stated that a passenger might take 2,275,122 such journeys with only one chance of being killed. At two trips per day this would require 3,792 years. If, for instance, the fatal accident should happen on the last day of the period, it would have been necessary for the traveler to start his program of two trips per day in the year 1879 B. C.—*Science Conspectus.*

AN INCIDENT is related in a recent issue of the *Electrical World* where a workman in a railway shop approached his foreman with a request for a new machinist's hammer, showing his former tool split into longitudinal halves as the result of a heavy blow. Being busy, the foreman, in a half-joking manner, said, "Take it to the electric welder; we're out of hammers." Without question the workman obeyed. Later the foreman noticed the man lustily chipping a nut, and asked him where he got the new hammer. The inquiry elicited the fact that the two pieces of the broken hammer, small and irregular as they were, had been welded electrically with a neatness almost defying detection. Whether this was an economical process or not has yet to be determined, but as evidence of the electric welder's skill and general usefulness the incident is well worth chronicling. No doubt many other similar repairs to hand tools have been accomplished in boiler shops, and it would be well worth while to have them brought to light. The time saved in such emergencies may often offset the increased cost of such repairs or the replacement of damaged tools.

THE EXECUTIVE BOARD of the Master Boiler Makers' Association will hold a meeting at the Hotel Sherman, Chicago, Ill., at 2 p. m., Friday, September 18.

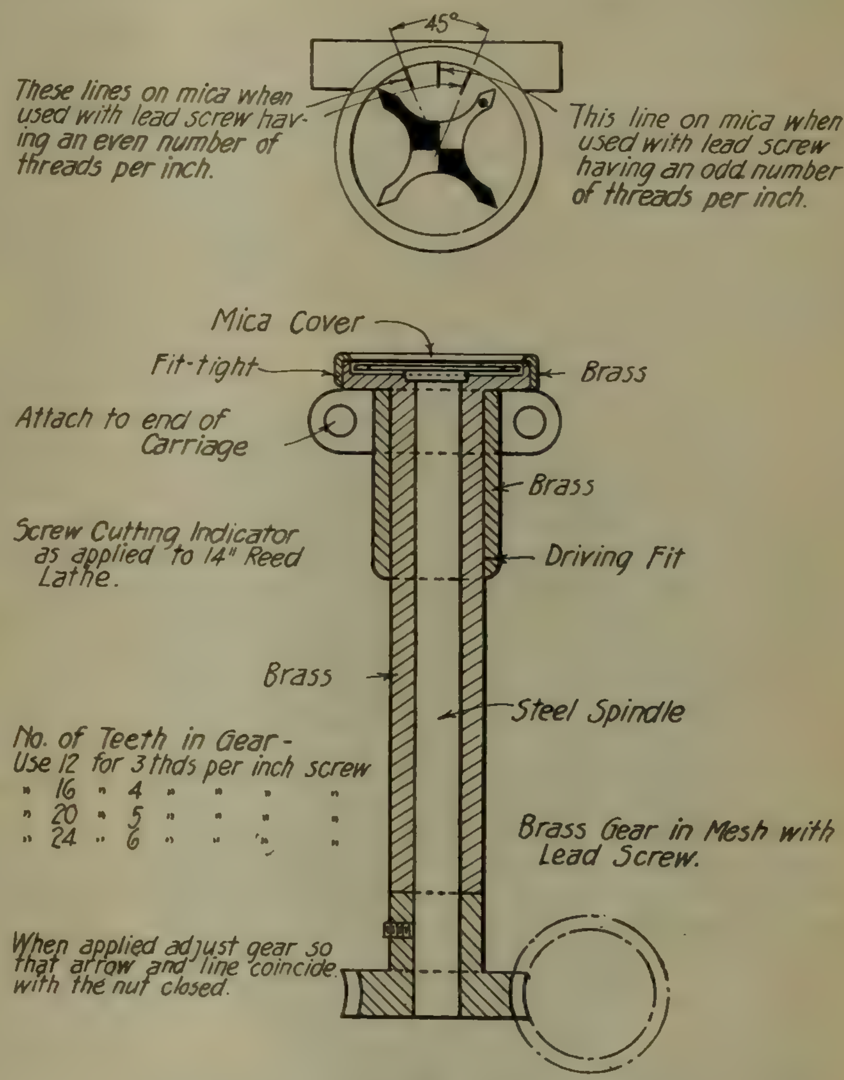
The Chicago, Milwaukee & St. Paul is said to be preparing to erect a roundhouse at Beloit, Wis.

SCREW CUTTING INDICATOR.

By W. C. Diebert, Tool Fmn., C. & O. Ry.

The screw cutting indicator, shown in the illustration, can be attached to any lathe and makes thread cutting much quicker, as it is not necessary to wait for the carriage to run back. Therefore, there is no need of the cross belt for reversing the lathe. Simply throw out the carriage, run it back by hand and engage the split nut.

The device consists of an indicator fastened to the carriage and connected by a brass gear to the lead screw. The steel spindle has an arrow-shaped indicator at the end, over which is a mica cover. A number of radial lines are drawn on the surface of the mica and the instructions for setting the device are as follows:



Screw Cutting Indicator.

For cutting any even number of threads per inch, not fractional, close the split nut with any arrow under either line, on all cuts. For any odd number of threads, not fractional, close the nut with any arrow under the same line. For any number of threads per inch containing the fraction ½, close the nut with the same colored arrow under the same line. For any number of threads containing the fractions ¼ or ¾, close nut with the same arrow under the same line on all cuts. All threads which are multiples of the lead screw can be caught at any point.

AT THE TIME of the Vera Cruz affair, the men working at the scrap platform of the West Albany shops of the New York Central & Hudson River raised a fund and purchased a pole and flag, the flag being raised with appropriate ceremonies. The men employed in handling scrap were of many different nationalities and took this way of showing their patriotism.

The Chicago & Alton has authorized construction of nine new stalls to its roundhouse at Brighton Park, Chicago, at an estimated cost of $12,000.

The Chicago & Eastern Illinois has purchased 75 acres of land at Terre Haute, Ind., as a site for yards, which will cost $150,000.

THE MAN AHEAD.

The man ahead believes in his proposition heart and soul.

He dispels ill temper with cheerfulness, kills doubt with a strong conviction and reduces active friction with an agreeable personality.

He mixes brains with efforts and uses system and method in his work.

He finds time to do every needful thing but never letting time find him doing nothing.

He makes every hour bring dividends, increased knowledge or healthful reaction.

He keeps his future unmortgaged with debts; he saves as well as earns.

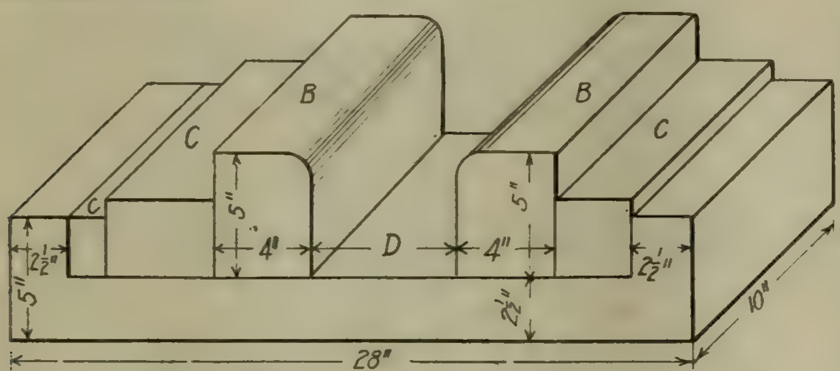
He steers clear of dissipation and guards his body and peace of mind.

That's why he is the man ahead!—*The Railway Storekeeper.*

DEVICE FOR BENDING IRON

By C. K. Abbott, Fmn. Blacksmith, St. L. S.-W. Ry., Tyler, Tex.

The accompanying sketch shows a handy and useful tool for bending many different shapes at steam hammer, such as driving box saddles, spring bands, carrier irons and many other parts of engines and cars.



Device for Bending Iron.

Plate A, serving as holder for block B, space D to suit the work to be done, filling in back of that with block C.

When work is completed there is no trouble in removing it, for making blocks B larger one way than the other gives them a wide range of usefulness. These dimensions can be changed to suit the work, steam hammer die, etc. This is a very handy device in a railway shop, especially one which is without a bulldozer.

New Books

INTERNATIONAL RAILWAY FUEL ASSOCIATION. Proceedings of the sixth annual convention. Leather, 6x9 inches, 343 pages, illustrated. Published by the secretary, C. G. Hall, 922 McCormick building, Chicago. Price: leather binding, $1; paper binding, 50 cents.

These proceedings appear this year in a handsome flexible cover of red morocco leather, with gilt edge, and the grade of paper and quality of the illustrations are in keeping with the rest of the volume. Among the papers and subjects discussed are "Honeycomb and Clinker Formation," "Relation of Front End Design and Air Openings of Grates and Ash Pans to Fuel Consumption and Sparks," "Uniform Methods of Computing Fuel Consumption," "Sizing of Coal for Locomotives," "Storage of Coal," "Modern Locomotive Coaling Stations," "Firing Practice," "Preheating Boiler Feed Water," "Fuel and Failures" and "Economies in Roundhouse and Terminal Consumption."

MASTER BOILER MAKERS' ASSOCIATION. Proceedings of the eighth annual convention. Paper, 6x9 inches, 177 pages, illustrated. Published by the secretary, Harry D. Vought, 95 Liberty St., New York. Price, $1.00.

This volume contains the official proceedings of the convention held at the Hotel Walton, Philadelphia, Pa., on May 25-28, 1914. Among the papers and reports discussed are, "Oxyacetylene and electric welding," "Chemical treatment of feedwater," "Load on staybolt and boiler braces,"—"Flexible staybolts vs. sling stays in the crown sheet," "Combustion chambers of large mallet and Pacific type engines," "Radial stays in crown sheets," "Flue cleaning," "Combustion and feed economy" and "Boiler inspection in service."

Personals

J. I. Fussell succeeds S. R. Kent as boilermaker foreman of the *Atlantic Coast Line* at High Springs, Fla.

M. K. Barnum, general mechanical inspector of the *Baltimore & Ohio*, has been appointed superintendent of motive power, with headquarters at Baltimore, Md. Mr. Barnum was born April 6, 1861, and was graduated from Syracuse University in 1884, with the degree of A. M. He began railroad work in 1884 as a special apprentice in the shops of the New York, Lake Erie and Western, now the Erie, at Susquehanna, Pa. He was then consecutively machinist and mechanical inspector, and later general foreman of the same road in Salamanca, N. Y.; general foreman of the Louisville & Nashville shops at New Decatur, Ala.; assistant master mechanic of the Atchison, Topeka & Santa Fe at Argentine, Kan.; superintendent of shops at Cheyenne, Wyo.; district foreman at North Platte, Neb., and then division master mechanic at Omaha, Neb., on the Union Pacific; assistant mechanical superintendent of the Southern Railway.

In February, 1903, Mr. Barnum was made superintendent of motive power of the Chicago, Rock Island & Pacific, and in April of the following year was appointed mechanical expert of the Chicago, Burlington & Quincy, and in 1907 was appointed general inspector of machinery and equipment for the same road. He left that road in April, 1910, to become general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley, remaining in that position until July 1, 1913, when he became general mechanical inspector of the Baltimore & Ohio.

F. C. Schorndorfer, general foreman of the *Baltimore & Ohio Southwestern*, has been transferred from Chillicothe, Ohio, to Washington, Ind.

W. F. Hayes has been appointed general foreman of the *Baltimore & Ohio Southwestern* at Chillicothe, Ohio, succeeding F. C. Schorndorfer.

W. C. Dietz has been appointed general foreman of the *Baltimore & Ohio Southwestern* at Flora, Ill., succeeding J. B. Harward.

M. K. Barnum.

S. D. PAGE succeeds H. A. Martin as general car foreman of the *Bangor & Aroostook*, with office at Derby, Me.

T. S. LOWE has been promoted to master mechanic of the *Canadian Northern*, with office at Limoilou, Que.

T. C. HUDSON has been appointed division master mechanic of the *Canadian Northern* at Joliette, Que.

A. J. IRONSIDES, district master mechanic of the *Canadian Pacific*, has been transferred from the Manitoba division to the Alberta division, with headquarters at Edmonton, Alta.

W. J. RENNIX has been appointed district master mechanic of the *Canadian Pacific* at Calgary, Alta.

G. GLASFORD has been appointed district master mechanic of the *Canadian Pacific* at Cranbrook, B. C.

G. F. SHULL has been appointed acting master mechanic of the *Carolina, Clinchfield & Ohio*, succeeding H. F. Staley. His office is at Erwin, Tenn.

W. C. FETNER succeeds W. A. McCafferty as general foreman of the *Central of Georgia* at Macon, Ga.

LEROY COOLEY has been appointed general storekeeper of the *Central of New Jersey*, with headquarters at Elizabeth, N. J., vice C. B. Williams, assigned to other duties.

C. B. WILLIAMS has been appointed purchasing agent of the *Central of New Jersey*, with office at 143 Liberty street, New York.

W. J. KING succeeds G. A. Gibson as roundhouse foreman of the *Central Vermont* at White River Junction, Vt.

J. E. FITZPATRICK has been appointed locomotive foreman of the *Chicago & Alton* at Bloomington, Ill. He succeeds J. H. Schmidt.

J. E. EPLER has been appointed superintendent of motive power of the *Chicago & Eastern Illinois*, with headquarters at Danville, Ill. He succeeds J. H. Tinker, resigned.

WILLIAM GERMER succeeds W. H. Booth as road foreman of equipment of the *Chicago, Rock Island & Pacific* at Little Rock, Ark.

GEORGE H. ECK succeeds P. J. Flynn as general foreman, motive power department, of the *Delaware, Lackawanna & Western*, with office at Syracuse, N. Y.

A. G. PHILLIPS has been appointed supervisor of machinery and tools of the *Delaware, Lackawanna & Western*, with office at Scranton, Pa. He succeeds W. H. Johnston.

JOSEPH BILLINGHAM has been appointed superintendent of motive power of the *Grand Trunk Pacific*, succeeding G. W. Robb, resigned.

J. H. GASTON has been promoted from general foreman to master mechanic of the *Georgia*, with office at Augusta, Ga., as heretofore.

WILLIAM O'BRIEN succeeds F. M. Baumgartner as master mechanic of the *Illinois Central* at Clinton, Ill.

FRED M. BAUMGARDNER has been appointed as senior inspector of motive power in the Central District of the Division of Valuation, *Interstate Commerce Commission*, with headquarters at Chicago. His experience has been with the mechanical department of the Union Pacific and Illinois Central, having served as roundhouse foreman, general foreman and master mechanic on the latter road and having recently been made master mechanic at Clinton, Illinois.

F. MERTSHEIMER has been appointed superintendent of motive power of the *Kansas City, Mexico & Orient*, with office at Wichita, Kan.

R. LISHMAN succeeds H. Batman as master mechanic of the *Mexican Railway* at Mexico, D. F., Mexico.

J. S. TAYLOR succeeds J. A. Jones as master car builder of the *Meridian & Memphis* at Meridian, Miss.

CHARLES MANLEY has been appointed master mechanic of the *Missouri & North Arkansas*, with office at Harrison, Ark., vice J. P. Dolan, resigned.

J. P. SINGLETON has been appointed master mechanic of the *Missouri, Oklahoma & Gulf of Texas*, succeeding L. M. Sleight. His office is at Denison, Tex.

J. J. SULLIVAN has been appointed superintendent of machinery of the *Nashville, Chattanooga & St. Louis*, with office at Nashville, Tenn. Mr. Sullivan served his machinist apprenticeship in the Kentucky Central shops at Covington, Ky., and at the age of 21 years he became machine shop foreman for the same road at Covington, Ky. Later he was appointed general foreman for the Kentucky Central at Paris, Ky., after which he took service with the C., N. O. & T. P. as general foreman of the shops at Ludlow, Ky. He resigned to accept service with the Louisville Southern as master mechanic at Harrodsburg, Ky. He left this road to accept the position of general roundhouse foreman for the Louisville & Nashville at Louisville, Ky., in 1891, after which he was promoted to the position of master mechanic at the Louisville, Ky., terminals of the Louisville & Nashville. He was later appointed master mechanic for the same road at New Decatur, Ala., and promoted to the position of general master mechanic for the same road, holding this position until his appointment as above noted. Mr. Sullivan is married and has two children. As one of his associates says, "Mr. Sullivan measures up to any big man in the business today."

JOHN A. MARSHALL has been appointed road foreman of engines of the *Northern Pacific* at Duluth, Minn.

J. B. NEISH has been appointed master mechanic of the *Northern Pacific* at Minneapolis, Minn.

JOHN HORAN has been appointed road foreman of engines of the *Northern Pacific*, with headquarters at Minneapolis, Minn.

RALPH E. HAMMOND has been appointed assistant road foreman of engines of the *Northern Pacific* at Minneapolis, Minn.

J. J. Sullivan.

E. E. CHRYSLER has been appointed superintendent of shops of the *Oregon Short Line* at Pocatello, Idaho, succeeding the late D. J. Malone. Mr. Chrysler was formerly master mechanic of the Chicago & Alton at Slater, Mo.

W. F. PIPER succeeds L. E. Rush as car shop foreman of the *Pennsylvania* at Mifflin, Pa.

C. M. FESSLER succeeds G. T. Trimble as car shop foreman of the *Pennsylvania* at Williamsport, Pa.

W. J. MILLER has been promoted to superintendent of motive power of the *St. Louis Southwestern*, with headquarters at Pine Bluff, Ark., vice T. E. Adams, deceased.

J. M. KILFOYLE has been appointed master mechanic of the *St. Louis Southwestern of Texas*, with office at Tyler, Texas.

E. M. SWEETMAN succeeds E. C. Sasser as master mechanic of the *Southern* at Spencer, N. C.

FRANK JOHNSON has been appointed master mechanic of the *Southern* at Princeton, Ind., succeeding E. M. Sweetman.

E. L. AKANS has been appointed master mechanic of the *Southern* at Birmingham, Ala., succeeding Frank Johnson.

M. PINEDA has been appointed master mechanic of the *Toluca, Tenango & San Juan*, with office at Toluca, Mexico.

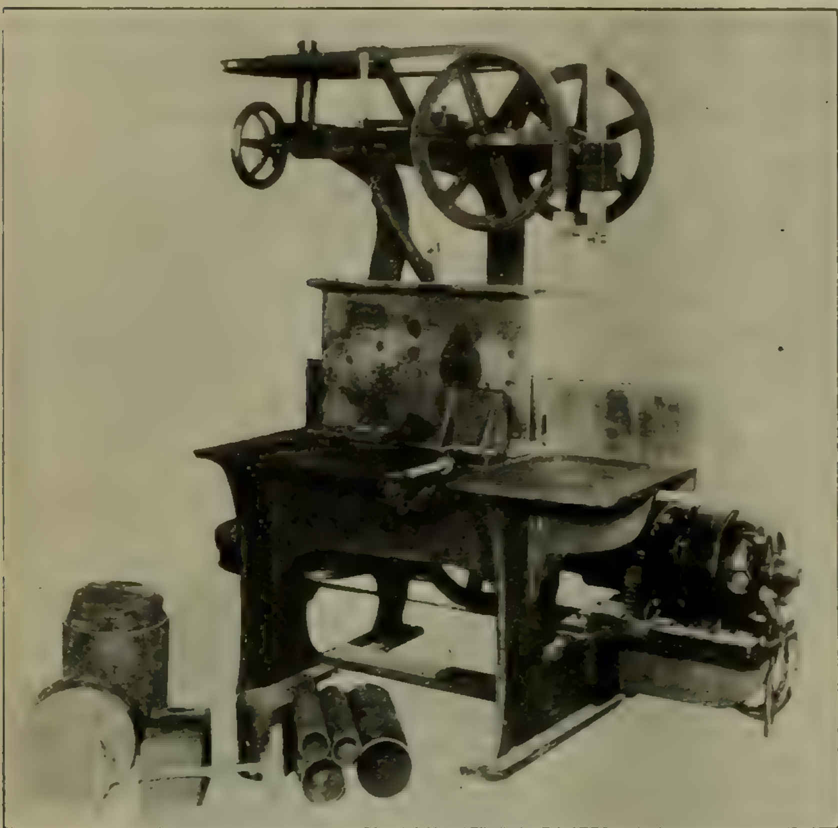
R. A. BILLINGHAM succeeds V. V. Clark as master mechanic of the *Tennessee Central*, with office at Nashville, Tenn.

Among The Manufacturers

METAL BAND SAW

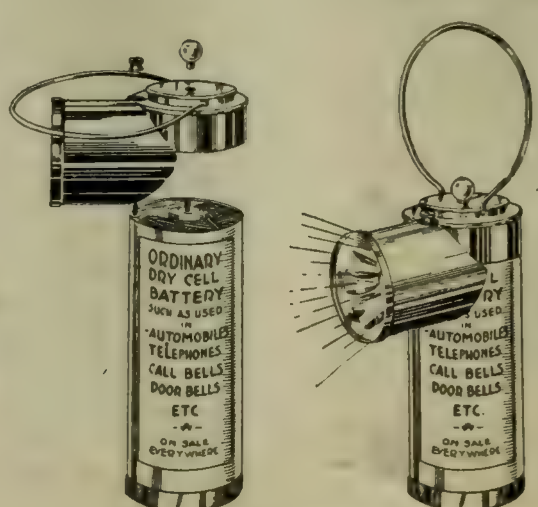
A metal band saw has been placed on the market by H. C. Williamson, 1840 West Lake street, Chicago.

This new Williamson metal band saw, selling for $175, has a capacity of a cold saw which would cost from $800 to $1,000, besides the necessity of having a grinder for grinding the saw and a high-priced man to run it. The Williamson saw is simple and easy to operate and a boy can take care of it, as it automatically feeds itself after cut is started. It is very seldom that a tooth is broken out of the blade. The back can be removed, giving a flat table on which to strap special work, and an automatic stop shuts off power when cut is finished. The large driving gear also acts as a pulley, and there are no delicate parts to wear or get out of order. The blades are inexpensive, costing only $1.65 each, and when worn out are thrown away or can be cut up and used as hand hack saws. Should the blade become broken, it can be brazed and put on to work again, as there is ample adjustment. Where it is difficult to cut tubing on a cold or hack saw, the band saw does the work without any breaking of teeth. It takes only one-half horespower to run it, making a saving over other methods of cutting which require considerable power. It will cut a 3-inch round in seven minutes, and will cut off a 5-inch superheater tube in two minutes. The table is only 20 inches high, making it easy to handle heavy bars, axles, etc., and the blade is so arranged that it can return to the rear of the machine, which makes it possible to cut any length of stock. Where it cost from $2.50 to $3.50 to cut a crankpin from an old axle under the steam hammer, the Williamson metal band saw will do it for less than 10 cents, it is claimed.



Williamson Metal Band Saw.

Kerosene Blow-Torch.



Electric Lantern.

ELECTRIC CENTER GRINDER.

The Neil & Smith Electric Tool Company, Cincinnati, Ohio, is offering a portable electric grinder to maintain accuracy of lathe centers, in which no dependence is placed upon the operator to adjust the grinder to produce an accurate result. All adjustments and the angle is a set unit, and the center can be ground in its own running position in three or four minutes, whereas the old method sometimes takes an hour. As will be noted in the illustration, the grinder has a taper shank which is inserted in the tail stock of the lathe in place of the regular center. The center of the spindle in the grinder and the center of the taper shank are in one line, and the spindle of the grinder is now at an angle of 60 degrees. The grinder is made interchangeable for use on different sized lathes in the following way: The grinder has a standard size hole and the taper shank that fits in the tail stock has a standard size shank on the end that fits this hole in the grinder. By ordering a number of taper shanks corresponding to the various sizes of lathes, the grinder can be equipped to keep all lathe centers in the shop to a 60-degree standard.

ELECTRIC LANTERN.

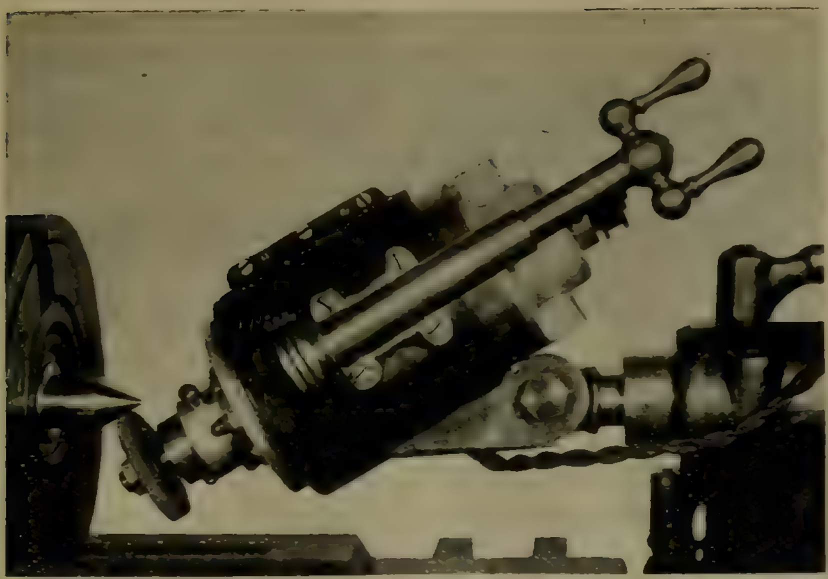
The illustration herewith shows in detail and assembly a device manufactured by the Syndicate Mercantile Company, Central National Bank building, St. Louis, Mo.

The device is essentially an electric lantern of great simplicity. It consists of an attachment to be used with an ordinary dry cell battery. It is attached quickly by connecting the battery posts through the shell of the metal top. The circuit is broken or completed by a thumb screw shown in the drawing. The light is strong and diffused—not concentrated as with a flash light.

The device seems to furnish an efficient lantern at slight cost. It is said that the ordinary battery used in this way will furnish a light for sixty hours intermittently.

KEROSENE BLOW TORCH

In order to reduce the fire hazard, railroads are abolishing the use of gasoline wherever possible. One source of danger has been the gasoline blow torch. Often when the workman fills the torch with gasoline, or when he generates gas preparatory to lighting, gasoline is spilled or sprayed in the vicinity and the burning match only is needed to start a fire that is dangerous to property and the lives of workmen. The more recent introduction of the kerosene blow torch offers an opportunity to get away from the danger of gasoline. In addition to the safety effected, kerosene develops 40 per cent more heat units than gasoline and this saving, together with the economy in cost per gallon of kerosene over



"Ideal" Portable Electric Center Grinder.

over gasoline, makes it seem probable that kerosene will quickly supplant gasoline as fuel for all blow torches.

In these days of "Safety First" the exploding blow torch presents a danger that the progressive railroad official is anxious to avoid. To meet the demand for a blow torch that insures safety to life and property, the A. & A. Manufacturing Company are making a kerosene blow torch which furnishes not only the desired degree of safety, but other advantages—chiefly those of economy of operation and greater heat per volume of fuel. The claim is made for this torch that no wind will blow out the flame. M. J. Egleston, 900 Lytton building, Chicago, is sales agent for the products of the A. & A. Manufacturing Company.

KENNEDY TOOL KITS.

A metal tool kit designed to serve the purposes of enginemen and shop men in carrying tools is shown in the accompanying illustration. These kits are manufactured by the Kennedy Manufacturing Co., 14 E. Jackson Boulevard, Chicago, Ill.

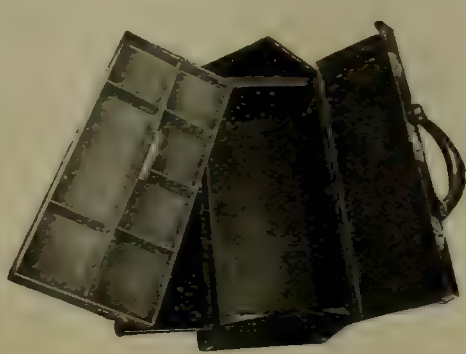
The kits are made of prepared steel but are no heavier than other bags and suitcases, their average weight being between five and seven pounds. They are built to stand the wear and tear of hardest usage, reinforced throughout, fitted with brass side-catches, strong Corbin locks, wire leather-covered handles, so riveted that they can't pull out, and protected by solid corner irons.

They are finished in a durable baked enamel of brown or black and present an appearance neat and attractive resembling leather travelling bags or suitcases.

Material, special features and overlapping construction make Kennedy kits water-proof, fire, oil and weather-proof. They are also thief-proof because they can be locked, chained if desired, and can not be cut open. Sharp or pointed tools can be carried without danger of piercing sides or bottom. Heavy material can be carried without buckling or changing shape of bag. The joints are riveted throughout.

The inventor, Mr. Kennedy, was for years an engine man on the Pennsylvania, and the necessity for a tool kit which could stand rough usage was impressed upon him. In designing the kits, he has arranged so that all weight falls upon the body of the bag and there is no strain on the hinges or cover.

Kennedy Standard Kit.



Kennedy Kit Open.

CANVAS CAR ROOFING.

By Wm. H. Adams.

It is probable that in proportion to its strength the covering of a car roof gets the hardest treatment of any portion of the car except the brake shoes and the couplers, but unlike these it cannot be made of chilled cast iron or drop forged steel. Formerly many roofs were covered with copper at large expense but such roofs could not long resist the crystallizing effect of the incessant severe vibration, the wrenching strains of the racking frame work, the corrosive action of the coal smoke acids, or the cinder scour to which they were subjected.

Very fortunately at about the time when the weaknesses of copper roofing were being brought to the attention of the master car builders with unpleasant emphasis a long series of tests and protracted experimental work came to a satisfactory issue and resulted in the introduction of a specially made canvas car roofing known as "Conservit" car roofing, which was able to stand the necessarily severe service conditions with entire success.

This fabric represented the results of the accumulated experience and expert wisdom of three lines of effort.

First—the fabric was carefully and painstakingly made along construction lines based on the knowledge and experience of the most successful manufacturers of high grade duck in the world, who succeeded in designing a fabric adapted to the end in view, strong in fibre and yarn to resist strain, yet thick and relatively soft in weave to hold waterproofing and to yield slightly to the racking and strain without impairing the effectiveness or integrity of the fabric.

The successful treatment of this fabric was the outcome of a campaign of several years' work on the part of a number of the foremost experts on the finishing and waterproofing of heavy duck, while the mechanical characteristics of the fabric and the correct methods for application and use were worked out by the freight and passenger car builders in the United States.

Its mechanical strength is greater than roofing copper yet it can be applied to irregular or rounded surfaces with the utmost ease. Instead of highly paid coppersmiths any intelligent laborers can apply such roofing and this ease of application greatly facilitates and cheapens local repairs.

An intelligent appreciation of the nature of the service and methods of application has resulted in this roofing being finished with a priming and tooth that makes it adhere tenaciously to white or red lead and which causes paint of any sort to cling to it permanently, although its natural dark brown color is not unattractive.

The manner in which it is prepared renders it permanently waterproof, practically spark proof and immune to the ravages of dry rot and mildew and it exercises a distinct rot preventative and antiseptic effect upon the wood with which it is in contact.

Owing to its strength and its continuous adhesion, it materially strengthens and holds together the roof foundation to which it is applied; moreover, the finishing so compacts and indurates the fabric that it resists almost indefinitely the various forms of severe wear to which it is subjected so that neither attrition nor the scouring of cinders has any appreciable effect upon its endurance, while coal smoke and sulphur acids are resisted on account of its waterproof qualities and the chemical nature of the preservatives and bitumens with which it is treated.

Similarly treated fabrics hold the long distance record for permanency and endurance as proved by the bitumen-soaked mummy cloths of the ancient Egyptians which have lasted through the centuries uninjured and unchanged.

The widespread use of Conservit car roofing has tested it in every climate and for every class of service, always with satisfactory results; and on this account it is steadily growing in popularity.

In order that all classes of service may be provided for, the roofing is made in widths from 22" to 130" and of various weights suitable for each particular use, and is carried in stock by the manufacturers, the William L. Barrell Co., 8 Thomas St., New York City, in the usual sizes, ready for immediate shipment for repair work or new construction.

New Literature

The Canton Foundry & Machine Co., Canton, Ohio, has issued an attractive booklet dealing with its portable floor cranes and hoists. These cranes are on wheels and are very handy for use about the shop in lifting castings off machines, lifting off steam cylinders, etc.

* * *

"The Young Man and the Electrical Industry" is the title of a story written by James H. Collins, the well-known magazine writer, which has just been issued by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. The little book deals with the opportunities afforded a young man in this industry and the different lines in which he may direct his activities, as exemplified by the works of the Westinghouse Electric Co.

* * *

Bulletin 34-W of the Chicago Pneumatic Tool Co., is devoted to illustrations and detailed descriptions of class A-0 "Giant" fuel oil engines.

* * *

"Maintaining Alignment on the Slides" is the subject of Forging Machine Talk No. 5, issued by the National Machinery Co., of Tiffin, Ohio.

* * *

The Ingersoll-Rand Co., 11 Broadway, New York, has recently issued two new catalogues, form 3024 and 3030, on Ingersoll-Rogler air compressors. The former, form 3024, is a complete treatise on the "Ingersoll-Rogler" valve and the latter covers the class ER-1 type of compressor. Both catalogues are profusely illustrated, showing the details of the machine in section. It is claimed that the new line of compressors therein described will deliver more air per horsepower input than other compressors, on account of the distinct advantage possessed by the new type of valve. The correct operation of the valve is entirely independent of all valve gear or other mechanism, resulting in the elimination of friction, added simplicity and high mechanical efficiency.

* * *

The National Malleable Castings Co., Cleveland, Ohio, has issued circular No. 52, descriptive of its malleable iron washers and bridge pin nuts.

* * *

The particular advantages of "NTC" regrinding valves are described in detail in bulletin 7-D of the National Tube Co., Pittsburgh, Pa. Three illustrations show a valve (from photographs taken at three different angles) which was opened and closed 327,094 times. After being reground several times this valve was opened and closed over 3,046,280 times and is still in use.

The Selling Side

Willard Doud, having completed the special engineering work in the construction of the new shops for the Belt Railway of Chicago, has opened offices in the Morton building, 538 South Dearborn street, Chicago, for the handling of matters pertaining to the design, construction, equipment and operation of railroad and industrial shops and power plants. Mr. Doud was formerly shop engineer of the Illinois Central.

R. L. Brown has resigned as sales agent of the Barney & Smith Car Company to become associated with the car building concern of Hotchkiss-Blue & Company, Ltd., Railway Exchange Building, Chicago, Ill.

C. W. Rhoades has been appointed manager of sales of the Daniels Safety Device Company, 327 South La Salle street, Chicago. Mr. Rhoades was formerly assistant sales manager of Valentine & Co., Chicago.

Graham Dedge, assistant sales manager of the Edgar Steel Seal & Manufacturing Company, Chicago, has been appointed assistant general manager also.

H. D. Shute has been elected treasurer and assistant secretary of the Westinghouse Electric & Mfg. Co., succeeding T. W. Simon, resigned.

T. P. Gaylord has been elected vice-president of the Westinghouse Electric & Mfg. Co., succeeding H. D. Shute.

The C & C Electric & Mfg. Co., of Garwood, N. J., has removed its Detroit office from 144 Seyburn Ave. to 1111 Chamber of Commerce Bldg. This office is in charge of R. K. Slaymaker.

The Chicago Car Heating Company, Chicago, has removed its southern office from 521 Realty Trust building, Atlanta, Ga., to 829 Munsey building, Washington, D. C.

The Transportation Utilities Co. of New York has opened a branch office at 1201 Virginia Railway & Power Bldg., Richmond, Va. This office will be in charge of Frank N. Grigg.

H. O. Fettinger has been appointed eastern railroad representative of the Ashton Valve Co., Boston, Mass., with office at 128 Liberty street, New York. He succeeds W. H. Foster, resigned to become associated with another company.

William M. Kinch, of the Gordon Primary Battery Co., died at his home in New York on August 29. Mr. Kinch had been connected with the Gordon Primary Battery interests for over twelve years.

W. J. McKone, sales manager of the Edgar Steel Seal & Manufacturing Co., Chicago, has resigned to engage in other business. Graham Dodge, assistant general manager, will perform his duties temporarily.

A. T. Gardner, for many years with the Landis Tool Co., Waynesboro, Pa., has accepted a position with the Modern Tool Co., Erie, Pa., and will cover the same territory.

James H. Van Dorn, president of the Van Dorn Iron Works, Cleveland, Ohio, and the Van Dorn & Dutton Co., died at his home in Cleveland on August 29, 1914.

Charles B. Yardley, Jr., formerly of Jenkins Bros., has been appointed manager of the railway department of the United States Metal Products Co., New York.

W. J. Johnson has recently been appointed a member of the engineering department of the Stentor Electric Mfg. Co., Inc., New York.

The Southern Wheel Company, of St. Louis, Mo., will erect a $60,000 building at its carwheel plant in Atlanta, Ga., and will increase its manufacturing of cast-iron wheels.

The Metals Coating Company has been incorporated with offices in the Peoples Gas Bldg., Chicago, to operate in this country under the Schoop patents, covering a process of coating objects of whatever nature and material with a great variety of metallic substances. This process which was originated by an inventor of Zurich, Switzerland, consists essentially in atomizing the coating metal in its molten state and spraying it over the surface to be coated.

The Pressed Steel Car Company has completed excavations and concrete work has been started on its new paint shop in McKees Rocks, Pa. The company also has started excavating for a new passenger car shop and store room, 60 by 100 ft., to cost about $15,000.

Edward P. Amory, secretary of the Western Railroad Association, was found murdered in his office in the Peoples Gas Bldg., Chicago, on August 12.

Thomas A. Griffin, chairman of the board of directors of the Griffin Wheel Company, died August 12 on a steamer en route from Yokohama, Japan, to Honolulu, H. I.

R. L. Wells, with offices in the Security Bank Bldg., Minneapolis, Minn., has been appointed Northwestern representative of the C & C Electric & Mfg. Co., covering the states of Minnesota, North and South Dakota, and the western part of Wisconsin.

J. M. Hopkins, president of the Camel Company, Chicago, has been appointed an executive member of the Railway Business Association.

Fifteenth Annual Convention, Chief Interchanges Car Inspectors and Car Foreman's Association

The fifteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America was held at the Hotel Sinton, Cincinnati, Ohio, on August 25, 26, 27, 1914. President F. C. Schultz called the meeting to order at 9:30 a. m. Rev. Henry C. Martin of St. Luke's M. E. Church, Covington, offered the opening prayer. Mayor Spiegel of Cincinnati was introduced and spoke in part as follows:

The work that you are going to do in your convention is typical of our country, when we realize the fact that the great country of Europe could not have such a convention as you are having today by reason of being divided into numerous nations and wars. It is indeed a great pleasure at this time to welcome you to the great inland city of Cincinnati, and I hope you will be able to call it in the future what it has been called in the past, the "Queen City of the West."

I might say to you that we have numerous attractions. We are now busily engaged in converting a canal into a bed for interurban railways. We are endeavoring to obtain a new Union Station, and to this end we need the aid of every railway entering Cincinnati, and besides that we have in Cincinnati numerous things which surely will interest you as soon as the clouds clear away. We have a water works system to which there is no equal in the country. Possibly some of you will be able to see it, and I am sure you will admit it. We have a municipal system of education which begins with the night schools which furnishes throughout the night schools for mechanics and those who are employed during the day—giving them an education during the night up to a university training. We have a system of education during the day beginning with the kindergarten which carries the child through our district schools and our high schools to the apex of the university, and we have a university which combines academic training with scientific training for which degrees are given, which gives our children an opportunity to become whatever they want to—academic training if they desire it, and the city of Cincinnati is doing it without any state aid.

President Schultz: I will ask Mr. O'Donnell to make a response to this splendid address of Mayor Spiegel.

Mr. O'Donnell: It is needless for the speaker to state that he highly appreciates the honor bestowed upon him by your president in selecting him to say a few words in response to the kindly welcome of His Honor, the Mayor of this beautiful city. Many of you have heard me say heretofore that the bulwark of our association rests in Cincinnati. If it were not for the indefatigable efforts of Mr. Boutet and his associates in the last ten years to get our association to the point where it is today, I feel (without any apology to the rest of our co-workers) that we would not have the number here this morning that we now have. I ask your pardon, Mr. President, for making this personal remark.

Your Honor, we appreciate all you have said to us. We come from near and far in this glorious nation which at the present time is manned by one God-fearing man, the President of these United States. We come when the clouds seem somewhat dark, but we come with the confidence that our country, which has always stood for justice and right and liberty, will be the pennant from which the warring nations will look in the future. We sincerely hope that your city will thrive and grow in the future as it has in the past.

I notice that in some of your statistics the tax rate is certainly an honor to the administration of this municipality. I am not able to tell what our tax rate is, but the city of Cincinnati with 15.52 a thousand is certainly a credit. It shows that you are working for the people. I was somewhat surprised to see that it cost $2.00 and some cents a head to protect the people with the police department. Down in our country it doesn't cost anything. Mr. Boutet says it has the best police force in the city. I haven't seen anything of it since I have been here.

Mayor Spiegel: I desire to correct one impression. We are hard at work preparing our budget, and if we had a levy of fifteen mills we would be the happiest municipality in the country. We are trying to get within five mills for the city of Cincinnati and five mills for all the rest of the departments, and if we have ten mills we shall be happy in getting along with all the departments, including the police.

President Schultz: I extended an invitation to T. W. Demarest of the Pennsylvania Lines to address the meeting this morning, but I am advised that he was called away and will be unable to attend. I will now call on Mr. Wright, chairman of the entertainment committee, to address you.

Mr. Wright: The kindly welcome given us by the mayor is simply in keeping with all the conditions that we have found since coming to Cincinnati. In the past eight or nine years our entertainment committee have not found a case where our work has been so arranged and such a welcome extended as we have received here in Cincinnati this year. The various places of interest that the mayor has mentioned we found were all laid out. Our work was picking out the ones that would best fit in our program—taking our choice and going ahead. This is largely due to the assistance given by the city itself to our committee in Cincinnati which took the advance work and helped us out. So this year our committee has little credit, but we have laid out a program.

Address of President Schultz.

In opening this, our 15th annual convention, I wish to congratulate the members upon the steady growth and influence of the association. I feel that not only the members of this association, but our executive officers, should be congratulated upon the forward steps that have been taken in the handling of interchange and equipment in the past few years, and particularly the results that will be accomplished when the changes of rules that were adopted at the Atlantic City convention the present year go into effect, as a number of changes were made which the members of this association had an active part in bringing about.

I want to call particular attention to a number of changes which I think are important and should result in revolutionizing the handling of car equipment in this country. The change in M. C. B. Rule 1 provides that effective October 1, each railway company must give to foreign equipment the same attention in the way of repairs that it gives to its own cars. In discussing this rule during our meeting here, I hope that the members will place such interpretation upon this rule as will result in carrying out the intention of the framers of this rule, which, as I understand it, means that foreign equipment away from home will hereafter not be neglected. I hope, further, that the interpretation placed upon this rule at this meeting will result in a condition that will prevent cars not fit for service from being interchanged after October 1. It is a well-known fact that it is the intention of railroad companies at all times to keep their own equipment in a condition fit for the loading for which it was intended and they are only offering it to their connections for loading in good condition. This rule provides that hereafter foreign cars must receive the same attention, and it is up to those who have charge of repairs to see that this matter is put squarely up to their car foremen to see that this rule is carried out. As I see it, the benefits to be gained from carrying out the wishes of the framers of this rule which received the unanimous support of the M. C. B. convention, will result in the investment in car equipment in this country being materially reduced, for the reason that we have heretofore been obliged to carry a maximum amount of equipment with the idea that a large percentage would be continually in bad order and, therefore, unfit for service.

From the observation that I have personally made, if the idea of this rule is carried out, and providing that we now have the proper amount of equipment to carry on the commerce of this country, I predict that if the equipment will be kept in shape, that the number of cars necessary to carry on the commerce of this country can be reduced at least 5 per cent. The saving resulting is apparent.

I also wish to call attention to the foot-note under M. C. B., Rules 37 to 42, which permits us to make an inspection of a combination of worn out and decayed parts and authorizing the handling line to make repairs to the car and bill the car owner, instead of the present plan under which we are obliged to make a joint inspection, report the car to the car owner, asking his authority to make the repairs, during which period car is held out of service carrying per diem, and the handling line had no assurance that the car owner would pay any attention to the communication and authorize repairs. I hope that those in charge of the car department will administer this rule in fairness and not saddle upon the car owner the cost of damage which is due to unfair usage and not to wear and tear as this rule intends. The operation of this rule will work a hardship on car owners unless it is carried out honestly.

A very decided step in advance has also been made in the change in M. C. B., Rule 120, and the elimination of Rule 121. Under the change in this rule, the movement of equipment home under home route cards has been abolished, and hereafter the car owners after having car reported in the proper manner must either authorize the handling line to make repairs or destroy car at his expense, allowing the proper credit for scrap. By the elimination of Rule 121, roads seriously damaging foreign cars must either repair or settle with the car owner on depreciated value, excepting in cases where they have direct connection with the car owner.

When these rules go into effect, I clearly see the necessity of a practical man in the office of the superintendent of motive power to pass upon the bills rendered under foot-note under Rules 37 to 42, and make a decision as to the advisability of requesting the handling line to repair or destroy equipment reported under rule No. 120. I also see the necessity of the railroad companies providing at large terminals sufficient facilities to take care of the foreign equipment that will necessarily be held up at large interchange points as the result of the enforcement of these rules, and this as I see it, can best be accomplished by the co-operation between the interested lines by establishing joint car shops in localities where the equipment necessarily will accumulate. Also, it is far more economical to carry a stock of foreign material at one or two locations in a large terminal than require each railroad company to stock up with foreign car material and for the further reason that car shop men employed by the railroads can turn out a great deal more work on their own cars than they can on a miscellaneous lot of foreign equipment. This will result in turning out more equipment by the car shop men employed by the home road on their own cars than if they were shifted back and forth on foreign and home equipment. It will also result in the men employed in the joint shops becoming more familiar with all foreign equipment by being obliged to work on such equipment at all times. In addition to this, when cars are destroyed under rule No. 120 a lot of material will be recovered that can be applied to cars that are repaired and not destroyed. Such facilities should, in my opinion, be located in territories where there is a large movement of loaded cars and an equal demand for empty cars to be reloaded. The saving here will do entirely away with the delivering of empty cars in such territories if the loaded cars are repaired and loaded out resulting in a large saving in per diem, as well as in switching charges.

I also wish to call your particular attention to the necessity of our members thoroughly familiarizing themselves with the safety appliance laws, and also to see that cars are not offered in interchange with defective safety appliances, and when equipment is found with safety appliance defects, it is promptly repaired.

Attention is also called to the growing feeling that the services of car inspectors can be utilized other than for the purpose of car inspection, and that they can properly record and handle seal records, and such other data that is necessary to make complete interchange reports in addition to the mechanical records now taken by them. This practice has now got beyond the experimental stage and is being encouraged by the executive officers of the railroads. All our members should assist in every way possible so that this practice can be extended.

The arbitration committee has been very kind to us in the last few years in taking us into their confidence in working out interpretations and changes in the rules, and I have reason to believe that at some future date they will again ask us to join with them in going over the rules in order to have a uniform understanding.

I cannot find words to properly express my appreciation of the work done by the entertainment committee, who have provided for the

members and guests of this convention, entertainment which we hope all will enjoy, and also to those who contributed liberally in order to make this possible. I feel deeply grateful to Mr. Boutet and Mr. Skidmore and the local members of this association who assisted in arranging details for the convention. Our conventions have always depended largely for their attractiveness and social enjoyment upon the presence of the ladies and children, of which I note a large number are present. I wish to extend to them a most cordial welcome and the thanks of the Chief Interchange Inspectors and Car Foremen's Association for their presence and aiding in making this occasion a complete success.

In conclusion I wish to thank the officers and members for the hearty co-operation in carrying on the business of the association for the past year, and hope that they will extend the same courtesy to my successor.

Mr. Boutet: I will ask the privilege of saying a word or two at this convention at this time. I think that all of our railroad officials feel proud that we have an organization such as we have, believing that it has accomplished a great deal of good in discussing the rules of interchange among ourselves and arriving at a common understanding on same, thereby facilitating the movement of cars through the country.

On behalf of the members of this association, I want to present to you Mr. Schultz for your faithful services in this organization, this beautiful gold emblem, which you have so well earned. It is our desire that you wear it for many years with credit to yourself and our association, and every time you look at it may it bring back fond recollections of each and every member.

President Schultz: I cannot express in words the appreciation that I feel towards the association, and especially towards Mr. Boutet, in receiving this badge. I have a recollection that I was interested in this association through the efforts of Mr. Boutet. I want to thank every one connected with the association for the kindness that has been shown to me in electing me to this office and the courtesies shown me since I have been in office.

The report of the secretary was read and on motion was referred to the executive committee. (See report of Thursday's proceedings.)

Mr. O'Donnell moved that the session hold over until 12:30. Carried.

President Schultz: We hope you will all give us your ideas so that they can be incorporated in the minutes. I will ask Vice-President Hanson to please read the rules.

RULE 1.

Mr. O'Donnell: It is my idea that the word running repairs caused so much confusion in the old rule that the Master Car Builders saw fit to eliminate it and it is up to any road handling cars to see that the foreign equipment is taken care of as well as their own cars, for commercial service as well as their own.

Mr. Forest: My understanding of Rule 1 is that it gives no distinction between your own car and a car belonging to your neighbor, and that we must take care of that car while it is in on our line the same as if it belonged to us.

Mr. Dement: The rule practically covers five points: inspection, oiling, adjusting brakes and repairs. It is understood that there is no charge to be made against a car owner for the packing and oiling, or for the adjusting of brakes, or for the inspection. Now what is the meaning of the word in regards to repairs? Will we have to repair a foreign car and absolutely give it to the car owner? The committee on revision turned down some of the suggestions relative to making a charge against a car owner for repacking and oiling. The rule relates to these five points.

President Schultz: Heretofore we would put the foreign car on the repair track. If it wanted a door stop we would put it on, and if it also wanted two sills we would not. We might as well give them all attention. That is what it means, and the car will be fit for service. As far as interchange is concerned, it should not be interchanged unless it is fit for the service for which it was built. It can only be returned to the delivering line under the condition accepted in transfer or run in switching locality and returned in same condition.

Mr. Trapnell: I understand the point raised by Mr. Dement was that Rule No. 1 provides that all of these repairs are gratis tnat we make to the car, including the inspection, oiling, packing and adjustment of brakes, and Mr. Dement says he does not understand whether it is in that position. He wanted to know where a line was to be drawn. If he will read the second line to Rule 2 it says everything should come under the provisions of these rules. It becomes owner's responsibility, and consequently a bill is subject to be rendered to the car owner and the car owner will have to accept same.

Vice-President Hanson: The remarks made by Mr. Trapnell are absolutely correct, as I understand it. Formerly Rule 1 read running repairs. There seemed to be a misunderstanding, or there was no uniform understanding, in regard to what constituted running repairs. The Master Car Builders want us, when we get a car on the repair track, to not only make what we call running repairs, but to make any repairs that are necessary to keep the car in good first class service. We want to consider all cars as far as possible home when they are on any railroad and the same repairs will be made.

In answer to the question in regard to making the repairs gratis, the rule covers all of these points and tells you what you can bill for and what you cannot bill for. This was discussed at several associations and they recommended that the word "running" be left out for the reason that they seemed to take advantage of the word "running," feeling that when they got a foreign car on their line that all that was necessary was to make running repairs. We want to get that our of the mind of all repair men, and the rules provide what you can bill for.

Mr. Elliott: My understanding of this rule is that we must make the repairs, regardless of what the repairs are and regardless of whose car it is. The most important point in connection with the rule is, when we go home are we in a position to make these repairs. We have got to do it and if we are not in a position to make them, it is up to us to see our superiors and tell them what we have got to have and what we have got to do.

Mr. Dement: It is the general understanding that we must go out and repack an oil box and readjust the brakes and make no charge against the car owner for that? I do not see any provision in the M. C. B. rules that won't allow you to make a bill against the car owner for these repairs. If you are not allowed to make a bill for adjusting brakes and repacking oil boxes, undoubtedly you are not allowed to make a bill against them for the repairs.

Mr. Hanson: Under the old rule, the word "running" was in there, you went out and put on an air hose or a brake shoe and considered it running repairs, but you can bill for it just the same. The word "running" was left out of the present rules so that you won't stop with slight repairs but will go ahead and make repairs necessary to keep the car in good first class service. I cannot see where there should be any misunderstanding in regard to the billing whether the word "running" is in there or not. You bill for whatever the rules provide.

Mr. Dement: But you do not make any bill for repacking oil boxes or adjusting brakes. Why not have the privilege of billing the car owner for that?

President Schultz: These are rules that are now laid down to work by. Of course any suggestion to change them will have to be made next year. It is a simple instruction and tells us what to do. I would like to hear a motion as to what the sense of this meeting is as to this rule.

Mr. O'Donnell: I move you that it is the sense of this meeting that Rule 1 is interpreted by this body as follows: That all repairs to equipment on any line, parties to the M. C. B. association rules, will be handled strictly the same as their own equipment for the upkeep of the cars.

Mr. Kipp: I understand from the motion that with foreign cars in our shop, if the trucks were not stenciled and repacked within 12 months, it is the sense of this association that our railroad should repack and stencil the trucks of that car. There isn't any railroad in the country following that practice. Foreign railroads are not going into the oiling and packing as extensively as that.

Mr. Boutet: I am heartily in accord with Mr. O'Donnell's motion. If we are going to get the cars in condition it is absolutely necessary that some money be spent in repairs not only to your own cars but to foreign cars.

Mr. William Hanson: In regards to oiling and packing, I think it is up to the company handling the car to do this in order to protect itself. I do not think it is necessary to renew all the packing or stencil, because there are no railroads doing that themselves. The foreign car should be taken care of in order to be run safely over the line. If you get a hot box the superintendent of motive power will soon tell you what to do. Other parts of cars are covered by Rule 107.

Mr. Lynch: I think Mr. Kipp is a little technical. I want the motion to prevail. In order to properly understand the rule, we cannot follow each railroad company's practice. This refers to shop practice.

Mr. Kipp: I am sorry to hear that talk about technicality. We are here as men to get a general understanding of these rules. We have a motion before us that it is the general understanding of this association that the same care shall be given to the foreign car as we give to our own as far as oiling and packing of journal boxes is concerned. There is nothing technical about that. We understand that. We read that in our proceedings when we go home and every car foreman in the country will say: "That is what you decided on at your convention." You come into the repair yards and find that your foreman is carrying out that practice and you say: "What are you doing?" He will say: "We are doing just as you agreed at the convention." It is evident to me that the Master Car Builders did not coincide with the recommendation that this association made that foreign car owners pay for the repacking of their cars. They cut that out and turned it down. They did not expect us to do it, otherwise they would have accepted our recommendation. We recommended that foreign railroads pay for the repacking of their cars if they had not been so treated within twelve months, and they would not accept it. I do not think that our motion is in order.

Vice-President Hanson: The reading of the rule might be misconstrued, but it says that we shall give to foreign cars the same care while on our lines that we do to our own cars. As far as the Lake Shore practice is concerned, we have what we call periodical repacking and we restencil our trucks. When we get a foreign car on our line we are not going to repack and restencil the trucks except when we change the wheels, in which case, of course, we repack the boxes but do not stencil the trucks. The only attention we give foreign cars is that attention necessary to handle them safely over our line. We do not pay any attention to the periodical repacking and restenciling. That feature might be misconstrued. I do not think as long as the arbitration committee and the M. C. B. Association has decided to not allow charges for such work, that there are any of us going to get paid for it. This association was in favor of it and I know two or three clubs recommended it. The argument that was put up against it was that some roads might stencil a car but would not repack it. If we are to be dishonest we can misconstrue any rule. I claim we can be just as honest in repacking a car as when we clean air brakes.

Mr. Brady: I believe Rule 1, if it is properly carried out, will do more to put the empty cars in condition to haul the commodities throughout the country than any rule that we have worked under for some time past, and the only thing for us to do now is to carry it out. I think it will prove to be of great benefit. As far as the oiling and packing is concerned, of course we will give the foreign cars such attention as they need. The important matter now is the repairs to be given to the cars.

Mr. Gainey: In regard to the packing of the boxes, this association, as well as the New England association, made a recommendation to the arbitration committee to the effect that the date of the last packing should be stenciled on trucks or other suitable location. The repacking of the boxes should depend on the condition of the packing rather than the stenciling.

The question was put upon the motion and the motion carried.

RULE 2.

Mr. William Hanson: In regard to the first paragraph, I find that we have a very poor system of defect carding practically all over the country, due to the fact that we are not educating our inspectors how to card. I feel that these inspectors are practically handling the company's pocket book. You will get a car at any interchange point where no inspector is located, it will have two or three siding boards raked, and the railroad that refuses this car at the outside point is not in a position to protect himself. The first thing they do at some points is to jump in and issue a defect card and I think it is wrong. I believe if a car is safe to run at all with a defect of that nature, that it should not be carded. The idea was to eliminate this a year or two ago, and the railroad that does it today gets protection for the reason that the inspectors only take a record of certain defects, not being sure in their own minds whether they should be carded. I think that is due to the fact that they are being carded at some point beyond the first inspection. I believe we should cut that out as far as we can and do away with defect carding.

Mr. Kipp: I believe all this defect card business is a technicality. (Laughter). Some particular point is getting technical. We cannot legislate brains into a whole lot of inspectors throughout the country. Mr. Schultz passes a car down to Mr. O'Donnell and Mr. O'Donnell would say in his judgment that the car passed Chicago and if it is

Messrs. Campbell, Boutet and Wallace. The barrel is said to have contained water.

safe for train men he lets it go. That is the way these things should be handled and not get technical about side boards being scraped.

Mr. Dement: The way I handle it, if a card is placed on an interchange car and it has a new defect, we immediately apply an M. C. B. defect card against the delivering line, but if the defects are old, we immediately take a record. Then, should the receiving line at some other point be called upon to furnish a defect card, we have the record.

Mr. Brady: I want to ask whether or not the carding of cars in interchange at various cities where there are chief interchange inspectors, carding is done under the supervision of the chief interchange inspector or whether it is done under the local car foremen of the various lines entering the city.

President Schultz: It is done under the supervision of the chief interchange inspector in all the large cities.

Mr. Boyer (Wabash): We run between two points where we have a chief interchange inspector at both points. When an inspector puts on a card and he says that the defects are not sufficient to card, the car passes on to the next interchange point, under the jurisdiction of the chief interchange inspector. His assistant looks over the car and shows the cost was right. We go back to the first man and say that a card has been issued against us and we would like to have protection at the first point on the record that we have which is denied us. Therefore it makes our company pay for repairs for which we are not responsible.

Mr. Devaney: I want to talk on the second paragraph. Is a foreign car originating from a trunk line, delivered to another trunk line, considered a home car when offered back in the same general condition? Or, in strict interpretation of this rule, if a party brings in a car with two draft sills decayed, or delivers it to the next fellow and he runs it on his line 100 miles and brings it in in the same general condition, will road No. 1 receive that car?

President Schultz: I think that road need not take the car back only in case the receiving line makes transfer and notes upon this car the defects. If he runs it 100 miles, he will have to take care of it.

Mr. Dement: Suppose Road 2 runs it and brings it in and puts a card on it?

President Schultz: Under this rule the only time that road No. 2, the receiving line, could get rid of that car is by making transfer, or by allowing it to go to a local switching industry. Properly side carding the car. If he in any way accepts this car his record won't do him any good after Oct. 1st.

Mr. William Hanson: I believe that when we pass a car at these interchange points—pass it to a certain line—that road should accept the car and use it. We are having considerable trouble out West. Some roads say that a car must have one-half inch clearance on each side bearing. What do you think about rejecting a car because it hasn't the amount of side clearance.

Mr. Lynch: That brings up a point as to what might be considered a car in safe and serviceable condition. Most roads would take the loaded car. I want to take the opposite position. If we take a car from you with two center sills broken and I return it to you in the same condition empty and you refuse to take it. Suppose I load the car to you again and it is still running, you say it is not serviceable when empty but it is serviceable when loaded. There is a point there as to what is a serviceable car. A car is serviceable under load and not serviceable when empty.

Mr. Pendleton: We are compelled to accept the loaded car. It does not make it compulsory to run the loaded car. He could send it on if he considered it safe to go forward. If he breaks the third sill and has penalties for a combination of defects for his negligence, it is up to him. You might accept the load in transfer and get paid for the transfer, and you can also get rid of the empty car and get it off your line.

Mr. Kipp: If a delivering line delivered to my railroad, or to the one I work for, a car with two defective center sills, if it is all right to run to destination 100 miles and unload, I so run it. And if we bring it back and offer it to the delivering line and it refused it, that delivering line cannot deliver any more cars to the railroad that I work for in that condition. We are not having any trouble along that line. If we bring a car back to them in as good general condition as when we received it, empty or loaded, they are receiving them back to us, and that is the proper way.

Mr. O'Donnell: I fully agree with Mr. Lynch, that we are going to have these old cars for the next five or ten years, and instead of having 1,800 or 2,000 transfers in our district per month, we would have 8,000, if we applied that rule. I want to tell you that the traffic department won't stand for that rule applied as our president wants it. We started in to apply it for two weeks and I guess we will all lose our jobs when the bills come in for transfers. All of these cars come from Cincinnati over the Big Four loaded with cotton. They will run them. The roads East of Buffalo will run them; it is fair, when the empty comes back in two weeks to say: "Take your car and repair it." We are taking all of these cars and there ought to be a limit of decency on taking the empties back for the reason that 70 per cent of the interchange are empties West bound; 95 per cent are loaded eastward. The cars that you take empty, if they put a load of coal in them you will take it, but you won't take the empty car. It does not sum up as it should, if we load 300 cars with coal and you refuse 150 just because this rule is in the book.

Vice-President Hanson: We have too much of this thing of taking old dilapidated cars and running them to destination and giving them to the other fellow. Under the new rule everybody is going to get busy, and they are going to commence refusing these old cars. If we refuse to take them from some other railroad, that road is going to say: "What will we do with these cars when they get to Cleveland or Buffalo. We are not going to have them on our hands. If we take the cars up there and they refuse them and transfer and turn it back to it, we have them on our line and we haven't the shop facilities to repair all of them. We are going to get busy and repair such cars before loading. We will find that it will revert to the owner of the car and he will get busy or get somebody else to repair them. The general tendency has been that they will take cars at Chicago, for example, and run them down to Buffalo or Erie as we think they are safe to go to destination or our line, it goes over the road all right but they do not want the car when offered to our connection, but they say they will run it 200 miles, provided you take it back from them 30 or 60 days later. We do not want to do that. We cannot say to the other fellow: "You take it back from us." We received the car and ran it. The place to refuse the car which is not fit to go forward is when you accept it from a connection, whether loaded or empty. If loaded, transfer and return car. We have had meetings in the last two or three months at different points of our lines, and notified our connecting lines that we are going to tighten up on our inspection so they could do the same. We feel we are receiving too many cars that are not fit to run over our line. The transportation department says the transfer bills run up too high, but when we show them the cars that we have refused and transferred I do not know of a single case where they have not said we were right. My superintendent of motive power has told us to tighten up and we have notified our connection accordingly. The Lake Shore has had hundreds of foreign cars that we have held for home route cards. We have some on our line that have been there over a year and they say we are not justified in asking for home cards, and under rule 120 we are not justified in holding the car. But they expect us to repair it.

Have all railroads the faciliites for repairing these cars? A great many of us have not and in order to protect ourselves we are going to refuse them from the other fellow in transfer. That is why I am going to stand by the president in what he says on the loaded car. If we accept a loaded car when we consider it safe to run, we should not expect the other fellow to take it back. If it is an empty car and he does not consider it safe, he should not accept it. But we should not be tenchnical but try to use good judgment at all times. There are times that a car can be run 100 or 200 miles with safety to avoid transfer and brought back; that is what we are doing at Buffalo now. But this is going back to the old practice of running cars on notation.

Mr. Stoll: In my recommendation to the arbitration committee last spring I asked them to give us a rule whereby the empty car should be received back in as good general condition as when delivered, and I gave my reason that in my locality we had half of the roads that delivered all of the full cars and the other half of the roads delivered all empty cars, so that the burden was placed on the roads delivering the empty cars continually. And the arbitration committee says these suggestions, as well as several preceding ones, having in mind that every car, whether loaded or empty, must be in serviceable condition, must be approved. Consequently, it says that empty cars offered in interchange must be accepted if in safe and serviceable condition. Therefore I think we would be over-reaching the limit if we approved the suggestions of President Schultz:

Mr. Campbell: We transfer between 800 and 900 cars a month on account of worn out condition. The western roads will not accept cars unless in first class condition, and they understand that under Rule 120 that if the car is in a worn out condition it is up to them to repair, or, if it cannot be repaired, it should be destroyed. We have got to transfer and they are transferring the same amount in the Twin Cities. We cannot deliver them.

Mr. Lynch: In regard to transferring these cars, it is my opinion that the railroad companies today are not prepared to enforce the rule as you suggest. They haven't the equipment and as Brother Devaney says, it will mean 50 to 75 per cent more transfers. Within the last few months at Buffalo the transfers increased 50 per cent. The expense of transfer is a small item when compared with the loss or damage to freight. It is a serious matter to the railroads as well as the delay to the shipment.

Mr. Campbell: Lots of cars offered in interchange are received all right under load, and when they come back they have a lot of rubbish in them. I have been sending them back to the delivering line and making them clean the cars.

The discussion was laid over until after lunch.

Mr. O'Donnell: Concerning refuse in cars, the refuse should be handled as bad loads; reject the cars and make delivering line clean them out.

Mr. William Hanson: At our meeting it was decided that all cars from which the receiving line got the road haul would be cleaned out at their expense. They gave the delivering line an order to clean the car out. That means $1.00 switching charge and the actual time for cleaning out the refuse and it has reduced the number of cars with refuse in. Any time we get a car we investigate whether it is a road car. If it is simply a switching car we do not give them anything. The road that delivers the car pays for cleaning out the car.

RULE 3.

Mr. Trapnell: I think paragraphs C and H conflict. It says cars will not be accepted in interchange after October 1, 1914, unless equipped with either No. 1 or No. 2 M. C. B. standard brake beams and then over in H it says that after October, 1916, cars will not be accepted in interchange unless equipped with all-metal brake beams.

Mr. Kipp: I would like to get the sense of this meeting as to paragraph M. Do I understand that it is obligatory that the delivering line shall chain these cars?

Answer: Not at all. If the delivering line sees fit to deliver without any chains, the receiving line has to receive the cars.

Question: Can the receiving line reject the cars on account of not being chained?

Answer. No.

Mr. Shaff: There are a lot of cars being hauled over the country with the door and all door fastenings taken off, and they are stenciled "Rough Freight. No door required." Why should those cars be offered in interchange? Should they be kept on the road that desires to handle them in such manner.

Mr. O'Donnell: Would you transfer a car if it did not have a door and was so marked?

President Schultz: It may be the pleasure of the receiving line to avoid a long return haul. It is not fit for lading.

Mr. O'Donnell: We have them right along with coke going away from certain lines and coming back empty.

Mr. Hilborn: If the railroads refuse to take them, who should stand the expense of transferring the load? That is the question he brings up. We handle quite a number of Pennsylvania cars and we make connection with two roads that will not receive them. Both the 'Frisco and the Seaboard refuse to take the car unless it has a side door.

Mr. Lynch: The question is what is a serviceable car. It may be serviceable for a certain class of freight, but not serviceable for the commodity for which it was built. In this case it is perfectly serviceable for that commodity, but what would the chair do in case that car were returned to Chicago?

President Schultz: If the car was offered to a connection and I had my choice in the matter, I would give a transfer against the delivering line for the reason that the car is not fit for service. If a road for its own convenience desires to run its cars in that condition, I would say it ought to keep them on its own line.

Mr. Stoll: I believe it is wrong to transfer cars because they haven't a side door and are stenciled for rough freight. These cars are used for a commodity that is not fit for a good car. You might just as well transfer a coal car. You cannot use a coal car for anything else only coal. You could run a car that was stenciled for rough freight just the same as you would a coke rack. You can use the car for lumber, oil or pig iron.

Mr. Devaney: How about the car for a return load? That is nobody's business about the return load. If you receive a car that has dirt in it and it is stenciled "No side doors required" that car is safe and serviceable. If they load, the freight on that is supposed to be great enough to justify that line to return the car back to the originating point empty.

Mr. O'Donnell: If I were looking for business I would let the car go through and forget it. You do not have to seal these cars.

Mr. Kipp: I am going to agree with Mr. O'Donnell. I believe that if a car is fit to carry the commodity with which it is loaded, we should let it go.

Mr. Pendleton: If we are all experiencing more or less trouble because of the fact that we haven't a uniform transfer rule, we just wondered whether or not the rule as applied there would permit you to transfer the car.

Mr. Devaney: If there is no law that will prevent you letting them go, and no law that will give you a transfer, how can you put a side door on and bill the owner. Where is there anything in the rule to that effect?

Mr. O'Donnell: Let's try them. Let us say this association is in doubt as to how cars marked "Rough freight" by certain roads will be accepted in interchange after October 1st, believing that this matter should be brought to your attention, we respectfully ask for your decision.

Mr. William Hanson: We do not reject a car that has the side doors either removed or lost, nor do we give a transfer order. I do not think that the stencil "No doors required" has any bearing. I know that doors have been put on right along and bill made against the owners, and I never yet heard of one being rejected.

RULE 4.

Mr. O'Donnell: As to the rights of the chief interchange inspector. It is the duty of the chief interchange inspector to pass on them as to whether a card should be issued.

President Schultz: We make settlement between the delivering line and the car owner, and it is given us the right to decide for them what is due them. The private car owner, if he is a member of the association, the chief interchange inspector, where there is one—represents the car owner and the delivering line.

Mr. Devaney: If that delivering line happens to be an innocent party, will the joint inspectors here agree that they will recompense the delivering line for the settlement the chief joint inspector makes at Chicago—a private line car run in Buffalo and it comes to Chicago—you say that they are entitled to more. Will Buffalo recompense the innocent line?

President Schultz: The inspection made by the car owner would be the final inspection, and the intermediate line that brought the car between Chicago and Buffalo would have to stand it unless they got relief at Buffalo.

Mr. Pentdleton: If a car is carded in Buffalo by the interchange inspector, nine times out of ten he is not going to cover the defects that the owner is entitled to. He applies a defect card and you make a personal inspection with the owners of that car, why wouldn't it be the proper thing to send that inspector up to Niagara Falls and let him have the bill come along just as it should. I believe we should do that and save a good deal of carding and billing. I believe we would be a great deal better off and save trouble.

Mr. Bayers: We have refrigerator cars that will be wrecked East of Buffalo somewhere. We as delivering line, would haul them back to St. Louis. They are carded at Niagara Falls for all defects that can be seen in interchange inspection. They come down to Chicago or St. Louis and in an inspection made by the owner by the chief joint inspector, a great many additional defects are found. A card was issued against the Wabash for the additional defects and it is up to the Wabash to get protection. In about one case out of 75 we will get protection and in the other cases the Wabash pays the difference. We have been trying to find some way by which we can get back at the receiving line for protection for these additional defects. I think Mr. Pendleton's idea is first class if we can bring it out.

President Schultz: The most trouble I had in the same manner was lack of complete repairs to cars that once had been in trouble. We could continually reissue defects cards for the same defect. I made up my mind that I would not issue any additional defect cards if a thorough inspection has been made in Chicago.

Mr. Hitch: I believe we should have a provision in the rules to cover just such cases of private cars. We have three or four cases now where our company is suffering the consequences and we know the points where the damage occurred in accident and we have no redress—simply up against it to bear the additional expense of additional carding on delivery home. I feel that the rule should provide for joint evidence on such cars as have been received home by private car lines and where the guilty party is located that originally damaged the car, there should be some provision made to compel the parties at fault to furnish the proper protection.

Mr. Paul: I find that most of the claims of the private line cars are where they are wrecked. The additional damage is generally for sills, and it may be that the car was wrecked five or six hundred miles away. I believe that there is an arbitration decision which does not permit you to strip a car to find such concealed defects, but still our line is being penalized for additional damage, as broken sills on refrigerator cars, and so far we have been unable to determine whether the inspection was made, or why the line should be penalized for broken refrigerator cars that had been in a wreck, as to whether they were damaged after the wreck or how that inspection was made. I would like to have your opinion and the opinion of this association as to why the last party delivering a refrigerator car to the plant after a joint inspection has been made, should be penalized for sills when there is an arbitration decision which says that you cannot strip a car for inspection after sent to the repair track.

President Schultz: I think it is entirely unfair to expect the owner to take a car home where all the evidence shows that it has been wrecked and you get closer and find a couple of broken sills. The arbitration decision was meant to cover where there was no other exterior evidence. The refrigerator cars have lining under the sills which prevents you from seeing and you have no right to assume that the sills are broken. It is necessary for the construction of the car and the car owner is responsible. We have not taken advantage of that anywhere a car has been wrecked.

Mr. Brady: I believe that the gentleman has reference to the decision that provides that it is not practical to strip a car for that inspection of the sills in interchange, and as I understand it when the cars had gotten home the chief inspector was called and the inspection showed that the additional damage was adjacent to the other damage caused by unfair usage. You go back to the chief interchange inspector located in the locality where the damage originated, and if that is shown he gives you a card for your inspection. I do not think that can be improved upon.

Mr. Boutet: The arrangement in Chicago as far as wrecked cars passing through Cincinnati has been very satisfactory. There hasn't been one bit of complaint that we could give to the exception of private line cars after having been wrecked and I am willing to take Mr. Bossert's advice on any car.

Mr. Devaney: Do you let them go on notation?

Mr. Boutet: We do not attempt to card them. It is almost impossible to enumerate the parts and have it satisfactory to the owner.

Mr. Pendleton: This morning we spoke about carding for defects that did not exist. We all know there is considerable of that carding going on, and I believe we should say to ourselves that when we go back home we are going to pay more attention to that and try to eliminate some of the carding. There is too much carding going on for slight defects that should not be carded for at all. Where we find a man falling down and not using proper judgment, let us correct him and we can reduce the percentage of carding.

Mr. Boutet: That same system was inaugurated at Cincinnati. While the inspector's card against the delivering line for defects, every foreman in Cincinnati has instructions and has issued them to his inspectors that if they find a car that has been carded in error they shall hold up that car. It is almost impossible to look at a card and tell whether they have carded more than they had, but by having the inspectors in line they will take up the cards and we will soon have the matter remedied.

RULE 17.

Mr. Hall read paragraph E and said: I have had several cases lately and been in several discussions on that point where it has been claimed that the solid beam is not as strong as the truss beam, for the reason that in 1906 the solid beam was not as strong on the transverse test, but on the direct test it was stronger, and I would like to know if a beam meets M. C. B. specifications which is tested transversely.

Mr. Radcliff: The M. C. B. proceedings give a test for the brake beam. If I were testing a beam I would be guided by M. C. B. proceedings.

Mr. Hall: I would like to know if a car is equipped with a truss beam and I applied an M. C. B. solid beam, if it is equally as strong as the other. It is on the transverse test but not on the direct test. I have claims where a solid beam, M. C. B. is applied to a car that is originally equipped with a truss beam. The rule is that it is at least as strong as the one standard to the car. It is as strong in one way but not in another. I would like to know which is the proper test.

Mr. Devaney: Mr. Hall's question is a good one. I have had a good deal of trouble along that line myself, and some six months ago I ordered a lot of No. 2 brake beams and I thought I knew how to order them through the M. C. B. Association. They came along with a U-beam, saying 5 pound to the foot. In addition to that they had 8½, which I think should be 8¼. I took it up with the manufacturer and they came back with a lot of specifications that were so hard for the ordinary man to understand that I quit, and I rejected the bill, and they proved to me that it was a No. 2 brake beam. We are applying them. Take the I beam; I think anybody who applies a masters' brake beam in place of any of these truss brake beams that measure a half-inch web, has an M. C. B. brake beam.

Mr. Radcliff: I wanted to know if it was understood by everybody that we would be getting joint evidence if cast iron journal boxes were applied in place of pressed steel and malleable.

President Schultz: Under this rule you can. It is wrong repairs.

Mr. Radcliff: Our line has 20,000 steel cars and a great number of them have malleable iron and pressed steel journal boxes.

Mr. Kipp: You can apply any kind of a box to a car; the cost to the owner must be no greater than the original construction.

Mr. Elliott: About the wrong repairs; he would be entitled to a joint evidence card, but if the box was put on before Oct. 1st, 1914, your joint evidence would be no good.

The president read paragraph B.

Mr. Boutet: We evidently are not of the same opinion or Mr. Radcliff would not have gotten up and asked that question, and to get the matter properly settled, I move that grey iron parts applied in place of malleable or steel parts, is wrong repairs.

The motion seconded and carried.

RULE 20.

Mr. William Hanson: You have provided for arch bar trucks but you have not said anything about pedestal trucks. How is he going to get paid?

Mr. Devaney: I have had some of these cases come up with private lines. I still believe what we have been doing will carry through. We made a special agreement. We raised them on the center plate and the side bearings and billed the actual amount to the car owner. That is a private understanding but if I would get a foreign car rejected that is what I would do and bill the owner.

Mr. Pendleton: If you have a Fox truck and put the proper raising under there of steel and rivet it back and it is just as fair to bill that at owner's responsibility the same as any other kind of a raise. You can bill for the material you use.

Mr. William Hanson: Where would you get the proper repairs from? What kind of material will you carry in stock to renew?

Mr. Devaney: We have all got bar iron and if it goes up 1½ we would use bar iron. The thin iron we would draw from the boiler shop. It is one of the easiest jobs to do.

Member: I have considered it proper to shim under the pedestal to the bottom of the truck.

Mr. Gainey: I think the young man is correct. It is the same thing as taking a wooden bolster truck and lagging the top of the spring; you get the same result. You bring the frame up and it is much quicker and in my opinion, a better job to do the way he suggests than to cut the center plates off.

Mr. Pendleton: I was wondering whether or not by filling up the spring cap the spring would be destroyed easier. These gentlemen who have altered a car that way ought to be able to tell us. If it does not, I do not see any reason why the job would not be just as good as the other and we all know it is cheaper.

Mr. Hitch: I move that by raising Fox trucks by shimming on top of the spring cap is proper repairs.

Mr. William Hanson: How are you going to raise the truck if you do not raise on the springs?

Mr. Elliott: I think the proper way to raise it is to take off the center plate and the side plate. It may be in certain conditions you can do that. Other times, I do not believe you can. It depends on how much you have to raise.

Mr. Stroke: The spring caps on both the journal box and the pedestal being only 1 inch deep, your truck is about 1½ inches low. Are you going to raise 1½ and leave ¼ of an inch on the springs when it is much better to cut off the four leaves and put in shims that thick? It is plain enough if you will simply consider that you are losing the seatage on springs, and can make a permanent job by removing the center plates and side bearings and putting on solid shims.

Mr. Devaney: We have ½-inch top and ½-inch bottom. How far would you allow us to go to raise those with wood? The motion ought to carry with it the distance we could do.

Mr. Gainey: As far as raising the height of the car is concerned, unless you bring it to the standard height, you cannot charge at all, and the rules allow you to bring it to the proper height and charge for it.

Mr. Elliott: The rules permit it, why should we say we should do it whether we know we can do it or not.

The question was put upon Mr. Hitch's motion and the motion was carried.

RULE 33.

Mr. Lynch: Is it the correct thing to do to weld a ladder step or a grab-iron? It is a common practice to weld a grab-iron, and I just wanted the sentiment of the body as to whether it is in violation of the law or not.

President Schultz: It says it must not be welded at the present time. I understand that after October 1st these parts cannot be charged to the car owner under any condition.

Mr. Lynch: Will these cars that are already welded be refused in interchange after October 1st?

President Schultz: They should be considered repairs. One condition that might enter into this. It says repairing or replacing ladders, handholds, sill steps or brake shafts, whether or not in connection with other repairs are delivering company's responsibility. If you had the end of the car broken off, owner's defect and at the same time the brake staff broken, then what?

Mr. Devaney: My understanding has been that since the recommendation was put to the arbitration committee, where we find a brake staff broken out at the same time—that is the reason they made this rule read this way, whether or not in connection with other repairs. Those defects cannot be cured unless under any condition.

President Schultz: If you want to be relieved from doing the work you are supposed to refuse the car.

Mr. Hall: There is an arbitration decision on that—No. 955—unless there is evidence to show that the cars have been side switched or wrecked.

President Schultz: I suggest that we submit to the arbitration committee this very question, that the balance of the defects are owner's defects. It seems to me the entire work should be charged, including the brake staff, ladders and handhold.

Mr. Burke: It seems to be that the rule is worded this way in order to avoid controversy in billing. They even give their reason that the car is not equipped according to safety appliance law, and even if you equip it, you could not bill the owner.

RULES 35, 36, 37, 38, 39, 41, 42.

Mr. Devaney: What is meant by that rule, when a combination of defects involves decayed parts; how far can a man go on that, before he involves Rule 120? If you find a car with two draft sills split and the end sill broken, what kind of a joint statement will you sign?

The President: The defects as you find them.

Mr. Devaney: What will I bill?

Answer: You bill for the three parts and any work in connection therewith.

Q. Now I get an inter-sill broken, what do you do?
A. The same thing.
Q. Two inter-sills broken?
A. Beyond that I would say no bill.

Mr. Devaney: I do not know where to divide this from Rule 120.

Mr. Pendleton: Mr. Devaney has brought out the supposition that we had two center sills with elongated holes and the end sill broken new, and two intermediate sills broken new?

Mr. Pendleton: I am going to tell you what I believe I would do. If a connection delivered the car I would issue a defect card for the two intermediate sills and end sill and sign joint evidence for the center sill.

Mr. Bossert: If you have a broken end sill and two draw sills new, the elongated holes will have no bearing.

Mr. O'Donnell: We have always understood that the refrigerator people would go the limit when the center sill showed previous old defects.

Mr. Devaney: When we make that bill, we have two broken inter-sills and an end sill that were broken new, then right on the same bill we will bill them for two draft sills split and decayed. Would that be proper? We ought to get together on that.

Mr. O'Donnell: I think Mr. Devaney would not ask the owner to pay for four or five items on longitudinal sills.

President Schultz: He wants us to express ourselves as to where we would make a cut-off.

Mr. O'Donnell: I never cite anything over three items.

Mr. Devaney: It isn't what we claim but what he gives. We want to know so we can start right. You have no right to cut that rule off any place until you get up to the eight sills.

Mr. O'Donnell: We recommend three or more longitudinal sills. That is evidence enough that the arbitration committee did not feel disposed to say that those sills could be broken, outside of two, by fair usage.

Mr. Dement: It requires a representative of some other line to sign that statement, giving in detail the actual condition of that car. If there is a combination beyond the two worn out sills, they also to go to them, and that statement to accompany the bill, and the only thing that can be against the car owner is the worn out sills or split sills caused by elongated holes.

Mr. Gainey read the arbitration committee decision on the matter.

President Schultz: It is not limited to any number of sills. It does not require that all of these parts should be decayed.

Mr. Trapnell: A car received with two worn out draft sills, the receiving line, or handling line, can make repairs and ask no authority whatever. In handling the car in that condition it contributes to the breaking of the end sill and the falling down of the draft timbers and the coupler, it necessarily causes some additional damage, and the rule says "or to sills split on this account." Why are they not owner's responsibility? It originally contributed to the condition of that car.

Mr. Carr: The rule says damaged end sills accompanied by two longitudinal sills is a delivering company defect. If you deliver a car in that condition you may repair it, provided you can get proper joint evidence.

Mr. Elliott: The rule says when a combination involves decayed parts. If you have three longitudinal sills worn out and two broken, you are entitled to get a joint statement from the chief interchange inspector showing the condition of the car just as it is and you should bill for the two broken inter-sills and also the decayed sills.

President Schultz: You have three broken longitudinal sills and one decayed end sill. How can you bill the owner under the present rule? They have gone one step further to permit you to make inspection which will be your authority to bill. The only question is how far can we go if we have a condition in which we have two decayed inter-sills and two decayed center sills and two new broken inter-sills? Can we bunch the whole thing and bill the owner?

Vice-President Hanson: If we have a car on our repair track and it has an end sill broken new and two center sills decayed or holes worn oblong, under the present rules that forms a combination. Instead of holding the car we make the repairs and return the car to source, we then take it up with the owners and explain the case and ask them for authority to bill. If they give us the authority, all well and good. If not we stand the expense. This rule has been revised to overcome this. If we have a car on our repair tracks after October 1st that has two center sills broken and an end sill broken, that is a combination, but if you have two more longitudinal sills that are decayed, you can have joint evidence and bill for the part decayed. But if you should have a broken end sill and two longitudinal sills split on account of holes worn oblong, you won't have to take it up with the owner or take a change on repairing. All you have to do is to have joint evidence signed. It is simply to overcome writing to the owners.

Vice-President Hanson: If you made a bill against the majority of car owners and you showed any defects that were evidently due to unfair usage, in a great many cases they object to entire bill under the new rules you can call in joint inspectors, and if you have four sills or six sills worn out, and you have an end sill broken new, you can bill for the whole thing. I move that our understanding of foot note under Rule 42 is that as long as there is no combination of new parts, that by having a joint evidence statement signed and sent in with the bill, you can bill for all parts removed and replaced, as long as there is no combination of new parts.

Mr. Trapnell: If there are two draft sills split and worn out, which is owner's responsibility, and there is an end sill and two inter-sills broken new, what is the delivering line responsible for? If there are three sills, an end sill and two intermediate sills that are broken new, is the delivering line responsible?

Answer: Yes.

Mr. Trapnell: And it says other sills, so that if other sills are damaged from the condition of the draft sill, doesn't that include them all?

Vice-President Hanson: No, sir, I do not see it that way. Under these circumstances you could bill the owners for any defect. You could take cars and run them when they are in a defective condition, and you may have two center sills that are badly worn and run them until some accident happens and you get a combination.

Mr. Trapnell: If you get a car in an accident there is nothing doing. If it comes out in the ordinary handling of cars, it is different.

Vice-President Hanson: The line handling a car is responsible for handling it in that condition. As I see it, it is to avoid holding the delivering or handling line responsible for sills that do enter into a combination of defects where it is due to worn out and decayed parts, and by having joint evidence signed and sent in with the bill you can bill for all those parts provided there is no combination of new defects involved.

Mr. Halbert: I would like to ask what constitutes a combination?

The President: Three parts.

Mr. Halbert: As I understand this rule it covers three parts. It does not cover five or six and when you get beyond these three parts, you are in the rough usage class. In St. Louis the way I am going to handle this rule will be if there are two decayed sills and an end sill broken new, I will issue a joint statement for the full combination. If in addition to that combination there are two intermediate sills broken new, or one side sill and intermediate sill, I will say: "Take your medicine."

Mr. Pendleton: We are still apart on this proposition. I believe that the rule makes the limit plain. I believe Mr. Halbert's idea is correct as far as signing joint evidence is concerned. The greatest

trouble we have is with center sills with elongated holes and split and pulling out. We tried to get them to eliminate the end sill from a combination and they would not do it, but they have other sills to take their places, and it provides for protection for the result of these conditions. I do not believe it goes further. It would not be necessary to have a joint statement if it was not intended that a man could bill for an end sill. If he was only going to bill for two sills it would not be necessary. Where two sills are split and he breaks the end sill then the man making the repairs can render bill against the owner. There is a combination of defects, and he cannot bill the owner without some authority, and they have given him this authority, due to the condition of the two center sills resulting from the other damage, but I do not believe that covers intermediate sills with side sills.

Mr. Lynch: There is another condition that has not been considered. There are quite a number of wooden cars that are equipped with steel bolsters and short draft timbers and it is not uncommon to find that bolster loose working back and forth, and it splits the longitudinal sills. The sills are soft. There are no decayed parts, but it simply wears them out, splits them, and that is a worse proposition than the two center sills. I would sign joint statement on a case of that kind where there is no elongated sills or decayed parts, but it is on account of the construction of the car. The wooden sills are not sufficient to bear up. We find that condition not infrequently, and I think that would be owner's responsibility, whether it took six or eight.

Vice-President Hanson: The question brought up was where we could make a cut-off. There are two things to consider. Under rule 120 you are either to repair the car at the owner's expense or they will give you authority to dismantle the car. Under rule 42 when you have a car with a broken end sill broken new and you have two or four center sills worn out, what is the difference whether you handle it under that rule or rule 120? The result would be the same. Some of you seem to think you could limit yourselves to three sills. If it is only the center sill and end sill that will form a combination. If the end sill is broken new and the two center sills were worn out you would have a joint statement signed. Suppose you had three or four longitudinal sills that were decayed and worn out; you could handle it the same.

Mr. Halbert: If a car has six or eight sills in it and they are all decayed, I will sign a joint statement against the owner; but where it has new sills with two longitudinal sills I do not look at it as a combination under our present rule 42. The rule to take effect after October 1st—the M. C. B. gave us that rule simply to eliminate the holding of these cars with car owner's defects, worn-out draft sills, instead of holding them as we used to prior to this rule, and the way we are doing now, to get owner's authority to bill. We can now, under this rule, repair two sills worn out and one sill broken new and put the car in proper condition. If a car has five or six decayed sills, there is nothing to prevent you signing a joint statement showing that condition. But if you only have two decayed sills and three broken sills, you are beyond the combination.

Mr. O'Donnell: We must all give Mr. Hanson the benefit of his argument. Let us wait until tomorrow when we will have a gentleman here who is with the committee in talking over these questions, and he might give us his opinion. I do not feel, from the decisions in the past and the feelings of the committee that decides these cases, that we will give you anything on the longitudinal outside of the three items. Mr. Hanson might be glad to pay for two or three sills if you would tell him that they were decayed. I think on the under frame that we should confine the joint evidence and the request to the chief interchange man to three items and nothing less. If there is any external cause, call them in.

Mr. William Hanson: The Interstate Commerce Commission has found objections to the 14-inch grabiron where a 16-inch could be applied. Whose duty is it to see where they can be applied, the interchange inspector or car owner?

Mr. O'Donnell: The point he wants brought up is whether the regular train interchange inspector generally employed should be safety appliance man.

Mr. William Hanson: I think you will agree with me that the officials should consider the idea of putting men on for that work and nothing else, because the law is going to take effect.

J. J. Gainey, G. Fmn. C. D., C. N. O. & T. P. Ry., Ludlow, Ky., and John L. Brady, G. Fmn. C. D., L. & N. R. R., Covington, Ky.

Mr. Boutet: The point brought up is of great importance to all of us. A car equipped with safety appliances by one road and in their opinion it is properly equipped goes to somebody else, who says that they did not put the grabiron on just right, and it is a serious matter for us to instruct our interchange inspectors that they must cut out cars that do not comply with the interstate commerce laws. Let us not censure the interchange inspector too readily. There are some radical things that exist. If a car is stenciled U. S. Safety Appliance, I do not believe there is anyone but what will take it up with the owner and let him send somebody to that road to see that they are properly applied. It is a serious matter to hold up freight, but if there is any repairs to be made to the car, I think the interchange inspector should take up that particular car.

Mr. Dement: I do not think we should be technical on these things as the owner thoroughly knows what he is doing. I will venture to say that Mr. Hanson is not the first man that caught one of these 14-inch grabirons, also that the government inspector knows every road that is applying them. The difference between a 14-inch and a 16-inch is a point of law. I believe if a 14-inch is good enough for one kind of a car it ought to be for another.

Mr. Gainey, Mr. Skidmore and Mr. Farrin were appointed as a committee to draft resolutions on the death of F. B. Boutet.

The convention then adjourned to meet at 9 o'clock Wednesday morning.

WEDNESDAY SESSION.

RULE 115.

Mr. Hall: I would like an interpretation of the last paragraph, where it says this paragraph will not apply to trucks belonging to individual ownership. Does that include all private lines, private stock car companies? If it were a truck of less than 50,000 capacity, I would be permitted to settle with the owner for the scrap value of the truck instead of the depreciated value?

A. Except for private ownership.

Q. It would be proper to settle with a private stock car company for depreciated value?

A. Yes.

RULE 120.

Vice-President Hanson: I would like to ask the opinion of the members, knowing that after October 1st if you get a car on your line in this condition it is going to be up to you to handle it as outlined in this rule, what are you going to do to protect your company to avoid getting such cars on your line? Are you going to continue to take a lot of equipment like you are taking today and run it, feeling that you are going to dispose of it under our present rule 120?

Mr. Campbell: The only thing you can do is when you get a car that is pretty badly worn out, transfer it, and if you haven't authority to bill for the transfer, transfer at your own expense and send it back. If you do not do that you are going to get loaded up. The western lines are doing that now.

Mr. Kipp: I am glad to hear Mr. Campbell talk that way. I am wondering where the worn-out western cars we get come from. It is a foregone conclusion that the eastern roads won't get any worn-out old cars if the western roads take care of them. As far as I am concerned, I would say that the most of us men here would have to follow out instructions from our general managers. That is all right, but if a competing line gets hold of some freight that we are handling and the complaint is made that we are too severe in our inspection, our general managers will jump on to us and say we are too close in our inspection and they are losing freight.

Vice-President Hanson: Mr. Kipp infers that if we do not tighten up on our inspection, or refuse to handle so-called worn-out and dilapidated cars, and some other road does take them and the attention is brought to the general managers, they will jump on to us and tell us that we have to take them. I think we can show him that we are perfectly justified. I can cite a case that recently occurred on the L. S. & M. S. The traffic department had informed our mechanical department that we were losing business on account of being too technical and unless we loosened up the business would be diverted to another line. I got in touch with the mechanical department of the road and their yard foreman said that we were perfectly justified in refusing their car. We did not lose any business and we still continue to refuse that class of car. We prefer to transfer them when offered to us and make the delivering line stand the expense of transfer, rather than haul them over our line 100 miles and have them transferred against us. I believe if it is put up to the general managers and they see the cars that they will sustain you in every case. I do not believe that there are any of you who are going to continue taking the old cars that you have in the past, knowing that when you get that car on your line you will have to dispose of it in some manner. Some of the members seem to be of the opinion that we will continue to take old, dilapidated cars. I am satisfied our management will not expect us to do that at all. If we take a car and run it from Chicago to Buffalo and it is on our lines 30 to 60 days, we won't expect the delivering line to take it back from us.

President Schultz: I think that if there ever was a time when the car men ought to use a little backbone, now is the time. If the car is transferred against you when it comes back, the first thing to do is to report it under Rule 120 and dispose of it. If one of these cars come to Chicago after October 1st then you better bid good-bye, because they will never come back. As soon as empty they will be destroyed or repaired, as the owner desires.

Mr. O'Donnell: Unfortunately the Master Car Builders have not inserted in the rule how much letter writing will be carried on to determine what shall be done with the car. It appears to me that they should have stated that after the receipt of such notice there shall be no alternative except to repair or destroy the car. The per diem is the basis of all our trouble with these old cars, due to the fact that if you hold an old car two or three months it is practically eating itself up. You never heard the trouble before the per diem was inaugurated. All of these old cars that this certificate must cover are cars that never reach the home line. We have cars in our district that the owner does not seem to care whether he ever sees them again. They are earning per diem and getting along fine. They do not care whether you send a car home, destroy it, or run it, so that they get the revenue out of it.

President Schultz: My understanding is that a car reported under Rule 120 automatically puts the car out of service. The per diem ceases and it compels the owner to act.

Mr. O'Donnell: He has the physical property but he has no per diem. Does that better the condition of disposing of the car?

President Schultz: Here is my understanding of it: A car owner will get a report of a car being in this condition; he is then obliged to give the reporting line disposition of that car. There is his car out of service, drawing no per diem. The only thing he can do is to block your track.

Mr. O'Donnell: There is nothing in this new rule that was not in the old to force the owner to give you definite advice within thirty days. He can come back and say: "That car was not in service long; you must have misused the car." In the meantime you are blocking your tracks. I want to say that I am fearful that you will be in no better condition after October 1st in getting rid of old cars than we were in the last two years.

Mr. William Hanson: We got into considerable trouble on Rule 120. Everybody says he will transfer this car. I have not heard anyone say that he would not load these cars. We ought to start to protect ourselves against loading, not only from an operating standpoint but from a mechanical standpoint. You want to get the agents educated not to load a car where there is no inspection, and we will get rid of a lot of bad order cars. You cannot stop it by letting the car get on the transfer track. There is going to be a lot of confusion because we do not all see the car alike. If I gave everybody a transfer who asked me for one we would transfer half of our equipment.

Vice-President Hanson: Whenever a car is transferred against us we get the movement of the car and find out where the car was loaded. It is taken up with the agent and inspector and each case is threshed out, and when this new rule goes into effect I believe that everybody throughout the country is going to get more in line to follow up the individual cases where cars are loaded on their own lines, if they have to pay for these transfers.

I agree with Mr. O'Donnell to a certain extent that the rule does not compel the car owner, or, in other words, they can carry this thing along for four or six months. The Lake Shore was very strong in trying to get a provision put in Rule 120. We asked for 30 days, if possible, or at most 60 days, within which to compel the owners to give some disposition on the car, or set a time limit. You should not leave it to their judgment. As I see the new rule, we can take it up with the owner and if he sees fit he can wait 30 days before he replies at all and he may ask them some technical question in regard to the cost of making repairs and simply say, as at the present time: "This car was on our line recently and we do not believe the car needs sills," and all that kind of stuff. You can have a lot of correspondence and carry the thing on for six months before they come out and tell you what to do. While it is too late to do anything now, I believe every road in the country should try to have the Master Car Builders' convention next year put a time limit of 30 days, within which the owner must give disposal.

President Schultz: I think 30 days is not as good as we have now. We haven't given him any option. We report the car to the owner and he must act or have it taken out of service. It does not draw any per diem. On joint inspection being signed the per diem stops. So it seems to be that we have the best lever.

Mr. O'Donnell: The roads that I work for have tried to obey that rule. There have been cases that correspondence has gone on for 18 months, and finally they were obliged to take car in and repair it at their own expense. If any member of the arbitration committee would put his eyes on the cars that I have mentioned he would say that the car was not worth perpetuating, but they have been obliged to spend $250 of their own money on a car that has not seen the home rails in eight years. If that is justice according to these rules, I do not see where the justice is.

President Schultz: Heretofore under Rule 120 there was no obligation whatever on the car owner to give you a home route card. Now he has two options to exercise. One is to repair, the other is to destroy.

Vice-President Hanson: Our president says there are two options. That is true, but there is nothing that says he must take immediate action. He says he does not want the car out of service. There are thousands of cars lying around the country that the owners prefer having on foreign rails because they have no use for them at this time. We have three cars at the present time upon which the owners refuse to furnish home cards, claiming we are not justified in asking for them under Rule 120, although we sent in the required reports and joint evidence and we called in several practical car men from other roads and the minute they laid eyes on the cars they said the cars should be sent home or destroyed.

Mr. Pendleton: In my terminal we have A. R. A. rule and 24-hour clause. If the defects are such as will exceed 24 hours, under M. C. B. Rule 107, we penalize the delivering line. If it don't, we penalize the receiving line. Are we going to run it and penalize the receiving line, take a chance on the car coming back, or shall we transfer it and tell them that the car is not fit to go?

Mr. O'Donnell: You could not give a transfer for any car that would not come under this rule. The transfer of load isn't going to come under this rule to any great extent. They have been empty in the district. You cannot load them. The transfer situation will more or less take care of itself. But these are floaters, short-haul movement. Will this rule be any better than the old?

Mr. Pendleton: That is true, but at the same time we know that it is going to a point where they haven't any joint inspection; when it gets to that point the other man is going to demand a transfer against the line, and the first thing he wants to know is why we permitted this car to go on his line; he was penalized for the transfer. A. R. A. rule would permit it and he pays an excessive cost of transferring at that point. We are the fellows that are going to answer to the receiving line for handling these cars.

Mr. Kipp: The point I wanted to raise has probably been decided by you through Mr. Pendleton's argument. My understanding has always been that where you wanted to give the handling line authority to repair your car your per diem did not cease. If you give the handling line authority to destroy the car the per diem did cease.

President Schultz: This was taken care of by the American Railway Association in its Code of Per Diem Rules which went into effect on August 1, 1914, and in which per diem rule No. 8 provides: "When a car unsafe to load on account of general worn-out condition, due to age, decay or corrosion, is reported to owner under M. C. B. Rule 120, per diem shall cease from date of such report. If owner authorizes the repair of such car, and no repair material is required from owner, per diem shall begin after repairs are completed, but in no case to exceed 60 days from date such authority is given."

Mr. Kipp: If you give authority to the handling line to repair one of our cars the per diem does not cease, and he explains it in this way: a railroad 1,000 miles long, while they are now obliged to move the car homeward, they might use that car on their line for a month after they repaired it in local service before they delivered it to some other line, so we would not know how long they had used it on their line, and they might have repaired the car a month before that, and it would make an endless chain, as far as the car accounts of the country are concerned, in keeping track of that car. They do not report that car out of the shop to our railroad.

Mr. Trapnell: Considerable talk has been had in this convention relative to the condition of the car on which you asked home route cards. You have been denied and the car departments of the various railroads have been using sharp practice in reporting cars for home routes which should not be reported, and the owner in a great many instances has furnished joint evidence on home route card and sent the car home. When the car arrived they found that the condition of the car as reported by the handling line, signed by some other innocent party, did not absolutely exist; that they were put to the expense of moving the car home while the car should have been repaired at a great deal less expense had it been properly reported. That makes a fellow very scrupulous about furnishing the desired information until such time as he gets positive information that the car is in the condition that it is reported. Let us be men and treat one another the same as we would if it were our own car, and sign up only for the condition of the car as we find it, and when we do that I believe we will have less trouble with the car owner. If he finds that the condition of his car is properly reported we will have smoother sailing. I desire to make one other little remark in answer to my esteemed friend Kipp. He laid great stress upon the matter that all the western cars that he got in were bad order cars. We find in the West and Southwest that all the old cars that should be scraped are eastern cars.

Mr. O'Donnell: Mr. Trapnell has one part of the question on reporting cars, but a car that he can use in the West is out of service in the East. The eastern lines want cars that are No. 1 for grain. The cars that we report for home routing would take from $80.00 to $150.00 repairs. Whereas, he can utilize them for his class of stuff in the West and Northwest.

President Schultz: We have personal knowledge where we are asked to sign home route cards. We are discussing a condition that automatically has been eliminated by our footnote, and I do not think that as long as a car is fit for service and can be repaired that the disagreeable condition will exist after October 1st, and we will only be confronted with a car that should be taken out of service.

Mr. Trapnell: I desire to answer Brother O'Donnell relative to the condition in the West and Southwest and Northwest—everywhere except in the East. We require cars for grain load. My place is right on the border of the greatest wheat raising state in the Union—Kansas—almost two million bushels this year. Don't we need grain cars? Haven't we got to have them? Haven't we got to have the cream of cars to move that commodity east, west, north and south? We go to enormous expense in our western country to prepare cars for grain. The cooperage, the burlap, the paper, the lath, the nails and everything else goes to make up a car that isn't in absolute perfect condition, and we put the car in shape to move the grain. We need some consideration in our end of the States because we move the product that keeps you people in the East from starving. Therefore, I say the remarks of Brother O'Donnell are all right for the East but more pertinent to the West.

Vice-President Hanson: In regard to what Mr. Pendleton has said, that under our new rules the car owner has two options, we to report the condition of the car, accompanied by a joint inspection statement; when we have done our duty why should we worry, as it is then up to the car owner. I think we have a whole lot to worry about and I guess every car man in the room will agree with me that we have a lot to worry about. We have a lot of cars on our line that we have been from a year to 18 months trying to dispose of. Our superintendents complain about the bad orders and say: "Why don't you do something with these cars? You have our yards blocked." That is why we tried to get a clause put in here that would set a limit of 30 or 60 days for the owners to give you disposition of some kind, and if they do not do it, you could go ahead and destroy the car. I think the new rule will work out better than the old rule. When we have asked the owner for authority to either repair or destroy the car, our troubles are not ended. As Mr. O'Donnell said, we have hundreds of cars on our line. We have inquired from some other railroads in the East as to how many cars they were holding for home routes and they tell us they have very few. Which goes to show that we were either too technical in holding up the cars and saying they were not fit for use, or the other fellow was paying no attention or trying to dispose of any of such cars. I am inclined to believe that a great many of the railroads stick some kind of a load in the car and shift it on to the other fellow. The fellow who has been trying to do right is the one who has been burdened with a lot of bad order cars. I recently cited a case at our Chicago meeting were one of our foremen gave us a statement that it would cost $175.00 to put a car in condition for all classes of service. We had a great deal of correspondence with the owner to get the car home; finally he furnished home route cards. After he got the car home he wrote us and said he simply wanted to call our attention to the fact that we had said it would cost $175.00 to repair the car, and when he got it home they put the car in good serviceable condition for $5.39. We all know what they did to the car. The same day I went out in the Collingwood shop yards and found another car belonging to the same railroad that had been recently repaired and stenciled U. S. Safety Appliance Standard, and the door posts were all decayed, the sheathing was out at bottom and all repairs that you could see had been done was a few end sheathing boards applied between the two end posts and a few on the side and one or two in the roof, or something of that kind. I do not think we should transfer any cars unless it is absolutely necessary, but the great trouble has been we go ahead and load them and the intermediate line thinks these cars will go to a certain point. He feels that he will take a chance. Invariably it will be refused by someone, and if that road then does what it should it is up to him to hold the car and get home route card. But he has been trying to avoid that responsibility, and when it gets on a line and is refused where a man wants to do the fair thing; that particular road is burdened with a lot of old cars and you have your transportation department and everybody wanting to know why you are holding these cars.

Mr. Devaney: I do not believe it will help relieve the bad order situation as it is. While our worthy chairman says the per diem will stop, we are not sure. But take it for granted that it does, lots of railroads have old cars and if the per diem will stop they will say to either repair or destroy that car; this rule does not give you

authority to go ahead unless there is a limit set to destroy that car if they do not answer you. It will never be worth the paper it is written on. Tightening up the inspection will not do it. When you tighten up the other fellow tightens up. It will increase transfer 50 per cent. The footnote to 42 is the solution of the problem. If the chief joint inspectors of this country will give the broad interpretation to Rule 142, it will cut down the bad order cars better than all the inspection and joint inspection you can make, because then people will be ready and willing to make repairs.

Mr. O'Donnell: I move you that the sense of this association is as follows: We fully appreciate the efforts being made by the Master Car Builders' Association to meet the suggestions of this association; we further feel that the new Rule 120, if sincerely interpreted by all the railroads in the country, will have a more or less desired result; but realizing what has taken place in the past, we ask you, as an executive committee of the Master Car Builders' Association, if it would not be consistent to take it up with all railroads throughout the country, to reply to this information more promptly, and if the replies are not received within a reasonable time, a joint certificate will be binding upon the owners of the car.

Vice-President Hanson: I would like to add to it that in the meantime it is our understanding from new Rule 120 that we immediately take the matter up and furnish the car owner a statement accompanied by the joint inspector's statement, showing the cost of repairs to the car, and that there are but two options for the car owner, to give us authority to either repair the car or destroy it in accordance with this rule, in order that they will know that that is this body's understanding of the rule, if so carried out, so that when cars are offered in interchange or show up at the terminal, we will know how the cars will be handled.

Mr. O'Donnell: Would you mind adding to that that we also further understand that the per diem ceases? Put that as a preface to my motion. Here is the idea that I would incorporate in Mr. Hanson's motion:

The Chief Interchange Inspectors and Car Foreman in convention fully appreciate the efforts that have been made by the Master Car Builders to clear up the situation on old worn-out equipment throughout the country which has caused us much trouble in the past, and we interpret the new rule effective on October 1st as follows: It will be the duty of any road having any such car in their possession to immediately call in the chief interchange inspector or one disinterested party to make out the necessary joint certificate as adopted by the Master Car Builders' Association and forward the same without delay to the owner, who will immediately respond as to the disposition of the car, in line with the sense of Rule 120.

We further ask the Master Car Builders' Association through its executive committee—realizing what has taken place in the past on such delays, that the owners of the equipment throughout the country be appealed to, to co-operate and reply promptly, in disposing of such cases.

Seconded and carried.

PASSENGER CAR RULES.

RULE 2.

Mr. Hackett: I want to ask if loose parts of a coach are considered concealed parts. A passenger car returns with missing material, gas sticks, step ladders; is that considered missing material?

Mr. Kipp: Tools are at owner's risk, so are the parcel racks in the car and the looking glasses. They can take a seat bottom out of a car and it is owner's risk.

Vice-President Hanson: We have had express cars come to us locked and sealed, and when the car is unloaded at Chicago or at the end of the line, various tools have been missing. It is our practice to make a check as soon as the car is unloaded and make a report of the equipment. In returning the car home the owners would ask us for a defect card for missing material, and we would tell them that we made a check on the car when it got to the destination and this material was missing, and as the car came to us locked and sealed we had no opportunity to make an interior inspection at that time and we know the material was missing when the car was loaded. In the majority of cases we are able to settle. Some refuse to settle but they still want us to give a defect card. These were especially baggage and express cars.

Mr. Trapnell: We do a good deal of interchange with passenger car equipment, tourist cars, and we use steam hose the year around. If a car comes to us from a connecting line with no steam hose applied because they do not use it in the summer time and it goes west, we have to apply it. In all probability the hose for the car is in the locker and we cannot get in there. Wouldn't that be owner's responsibility? Why not handle it as owner's responsibility? I believe we should have some method of handling these cars.

Mr. William Hanson: We consider a hose on a Pullman car owner's responsibility for the reason that the porters have exclusive charge of all material on the car. As to the other railroad equipment, we check all cars both ways, and when we find any shortage in equipment we defect card for same when the car is returned home.

Vice-President Hanson: As I understand Mr. Trapnell's question, the steam hose is not necessary while the car is in the East, but they want it applied when the car gets West. I should apply it, but when the car gets to the end of the line it is up to them to take the hose off. We have cases where one company will use a certain hose that won't interchange with our couplings, and it is up to us when those cars are offered us to change the hose and keep the hose at that point, return them to the owner, or put them into car at our own risk, and when car is returned to them we can replace their hose. We consider that it is our funeral to see that the cars have proper hose on while going over our line.

Mr. William Hanson: We have the Pullman people furnish the hose fittings and charge them a half hour for application of all steam hose on cars that are not so equipped.

Mr. Carney: The Master Car Builders have a standard steam hose now, but it isn't the standard head where they are having their trouble; it is the lock. Every road has a different lock and we have a great deal of trouble. Our people in the East won't allow us to run a hose with a different lock than our own, consequently we have all this trouble of changing the hose. The New York Central changes the hose and charges us up with it, and a great many go back over the Lake Shore, and they have the benefit of that hose. In that case the N. Y. C. should get the hose back from Buffalo and turn it over to the owner. In regard to missing material on passenger cars, it seems to me it is a poor rule for a company to get a coach from a neighbor, pay him $10 a day for it and steal all the equipment. I do not see where you are going to get any coaches.

Mr. Kipp: The hose question has all been taken care of. They recommended a 1½ hose and that does away with the 1⅝. The difference has always been with the head. You could not apply a 1⅝ with a 1½. We have quite a number of cars and we find quite generally that where a car goes west some western road will apply a hose where we allow the car to leave our line without hose, and we have always stood for them, and it is the same way with any of our western trains. When a car leaves our terminal, if the weather is such that a hose is required, we apply the hose and bill the owner. The conditions on our own individual road we control. As far as taking air hose off of the passenger equipment, when we get on the other fellow's line, if the conditions are such as to require a hose, and he puts it on a car, and it is standard hose, you have got to pay him for it.

Mr. Hitch: I do not know of any one appliance that has been applied to passenger equipment where there has been more money involved to the railroad company to manufacture than the steam hose couplings, and I feel that it is just as important that we should have a standard steam hose coupling as it is to have a standard M. C. B. coupler, and I would make that as a motion.

Mr. Gainey: I agree with Mr. Hitch. I believe this association ought to make a recommendation and have a standard coupling, the same as hose. One road uses one size and one another, and if you are interchanging one car in two service, you have got to change the hose. You have got to change them in bad weather and when you are in a hurry, and probably only part of the train goes through. You have got to change the hose on one or the other to get the coupling in there. We should have a standard coupling that will interchange with one another just the same as an air hose.

In answer to Mr. Trapnell's question about billing the owner. If we receive a tourist car on our line and we have to put steam hose on it, we ask the porter for the steam hose. If he has none, we have him give us a receipt that we furnished this steam hose, and we make a bill of that receipt.

Mr. Kipp: I move that a committee of three be appointed to decide this question on the steam hose and report tomorrow morning.

Seconded and carried.

The chair appointed Messrs. Gainey, Hitch and Kipp to serve on the committee.

Vice-President Hanson: It hardly seems right for the Pennsylvania, for instance, to get eight or ten Lake Shore passenger cars to use in excursion service and pay whatever the price is, say $10 a day, and when these cars come back to us and all the tools have been stolen out of the cars that be considered owner's risk. It seems to me that should be a delivering line risk. It is up to them to protect our property while on their line.

Mr. Kipp: My understanding, from information that I have already got from one of the committee, that the delivering line is not responsible, that the owner is responsible. The only alternative we have is to take out everything that is liable to be stolen. We are already prepared to take out the fire extinguisher and step ladders and our legal department is looking up the question of whether or not we can take out any of the tools. You see, nowadays there is no use for a hammer and saw and ax in a steel car, and there are some roads that are not carrying them today.

Mr. O'Donnell: Mr. Kipp does not make reply to this question. Suppose the Erie would borrow 10 cars for excursion service, is it your idea to strip the cars or give them tools and let them come back with all the tools in place or a defect card?

Mr. Kipp: I would say that it would be up to the roads in interest, and if the road using the car had courtesy enough to reimburse for the parts all right, but under the rules it is my understanding that we would be the loser. When you set it off at the junction point it was all right and the owner comes along and finds this, that and the other gone.

Mr. William Hanson: I would like to have you read the preface of the appendix to the code of rules, and I believe that you will find that any parts lost through unfair usage are at delivering line's responsibility.

Mr. Hitch: This rule covers inside or concealed parts, not line expense, and it so says—Rule 3, Paragraph c.

Vice-President Hanson: The reason I raised that question was, I think we ought to have an understanding between us as to whether or not it is the opinion of this body that that also includes cars rented to other lines. Personally, I feel satisfied it does not, and that we should hold them responsible for missing material. We have instructions to all of our points that when cars are delivered to another line, under these circumstances, they are to make a complete check of all the equipment, and we expect to get pay for them if missing when cars are returned. I think we should have a uniform understanding.

Mr. Gainey: If we take anything out of your car it is unfair usage. I move that the subject be continued in our discussion tomorrow morning.

Seconded and carried.

And thereupon the convention adjourned until Thursday morning in order that all might enjoy the boat ride and good things in store at Coney Island.

THURSDAY SESSION.

Mr. Devaney: Now that Mr. McMunn is present I will state the question we had up Tuesday. Before I hear from Mr. McMunn I want to get an expression from every chief joint inspector here as to just how far he would sign joint evidence wherein it involves decayed parts. In case two draft sills were split in a car and end sill broken, what is the proper way to sign that joint evidence? The next with the inter-sill broken; the next is the same with two inter-sills and end sill broken and two draft sills split or worn out. The next condition will be two inter-sills broken new, end sill broken new and two draft sills split and two draft sills decayed. I would like to know just how they would handle that at their different points.

Mr. O'Donnell: The contention of the opposing side on that paragraph was to the effect that the thought of the arbitration committee in adopting this rule was more or less to cover the two center sills which were elongated and split due to the bolts working when the end sill, which may be entirely new, may be broken with the two center sills, which form a combination of three parts. If you have a condition existing like that, and in addition that, after a combination is brought about, there are any decayed parts, especially on the underframing of the car, such as inter-sills or side sills, it would not be just—taking that rule as a basis, to sign joint evidence and apply to the owner for permission to repair for the reason that the combination is all that we should be expected to pay for. When you go beyond the combination, you are asking the owner for something that he should not be permitted to bear.

Mr. O'Donnell: If the superstructure of the car, the door posts,

the sheathing, or end posts, or any portion of the body or the roof was decayed, in addition to this combination of parts, they might give it proper consideration, but they certainly would not entertain joint evidence for anything over the three identical parts that go to form the combination, outside of center sills. We have had an enormous lot of cases where center sills will let go and they have been weak for a year or more, and the owner should in justice bear the expense of the repairs. Those are the two opposite views.

Vice-President Hanson: My contention is, as stated yesterday, that under the new rule if we have a car with the end sill broken new and two center sills broken new, that is a combination the same as under the old rule; we could not bill the owner for that. If we have an end sill broken new and two center sills broken on account of holes worn elongated and the center sills split, we can bill them for all after having joint evidence signed showing the condition, whether it is two, four, five or six. But if two center sills are broken new and the end sill broken new, these three form a combination; if we still have three or four other sills that are worn out and should be repaired at the same time, by getting this joint evidence signed, we can make bill against the owner for the other sills.

Mr. Boutet: This convention has asked the arbitration committee for four or five years back to eliminate in some words the end sill making a combination with two draw sills. We have practically got that through joint evidence where we state that two draw sills are worn out under use and the end sill broken on account of the condition of the draw sills. After the first of October it is not necessary to sign joint evidence, except to send in with the bill, and we must pay it. If we have two draw sills and end sill broken from worn-out condition of the draw sills, and then to say that we have decayed end sills, what a loophole it would leave to say that we have eight sills broken and get a joint statement from some other system to show that the owner should pay for all of that. Is it fair? Would we be treating our neighbor right? How many of us have had a side sill or an inter-sill decayed bad enough to have been renewed, unless it should have been renewed before? They would not renew, still we are going to make for somebody too many wrong bills against car owners.

President Schultz: Rules 40 and 41 now state that a combination of end sills and two longitudinal sills form a combination for which delivering line is responsible, except in cases where one of these three items is decayed and the other two parts may be broken new, and is a condition under which we may sign a joint statement which will be authority for the handling line. It does not require three decayed parts to bring about this combination, but if one of the three parts is decayed, then automatically we may bill the car owner upon joint statement for repairs.

Mr. Lynch: The footnote explaining that matter says when a combination of defects involves decayed parts, or involves longitudinal sills. It is all in the plural. If the one decayed member, or, rather, if the additional two members are broken, as a consequence of the decayed member; then I would say it was all right. I would sign a joint statement. But if the two broken members are not the result of the decayed third member, then I do not think it would be fair to the owner to sign a joint statement.

Mr. Gainey: For the last four or five years this association has been recommending to the Master Car Builders that they take that end sill out of the combination so that proper repairs can be made while the cars are on the repair track. It has been the practice where you have two decayed and an end sill worn out, the car foreman will put the two draw sills in and let the end sill go because he could not get paid for it. I think the Master Car Builders recognized that fact, and we can go that far on Rule 42 as to allow you to make the proper repairs. When you go further you will have to use Rule 1. My reason is that a good many roads throughout the country have placed a price where they would destroy their cars. That goes from $15.00 to $25.00. If you take some of the arguments we have heard here where you put in seven or eight sills and it runs up to $100.00 a man is not going to stand for it or pay you for it.

Mr. Stoll: When there are two sills beyond the decayed part you can sign joint statement; you could not with three sills.

Mr. Elliott: We certainly ought to be practical enough to know what a car owner should do with that car. There are certain kinds of cars we would put six sills in. I think that is something that we will have to leave for the time when we get to the car. I personally feel like the president—that we have to have a combination of broken parts; if you have four sills decayed and two broken, I believe that the arbitration committee intended that the car owner should bear the expense of car owner's defects, and the value of sills or elongated holes are car owner defects.

Mr. Halbert: The arbitration committee refers to a combination of three parts. If you have any other combination, as I see it, they make provision in Rule 120, providing for worn-out or decayed parts. If it is broken new, as I see Rule 42, it gives no connection when it goes beyond the three parts.

Mr. Burke: There is one point that has not been brought out. Take Mr. Devaney's car that has two inter-sills broken new and an end sill broken new and two draft sills split and worn out. You take it for granted that you repair that car. What can we do with the two draft sills only. The arbitration committee have defined how far you can bill when you repair a combination. I believe if you repair these two inter-sills and the end sill and the worn-out draft sills, it would be your case. I do not believe you could bill the two worn-out sills.

Mr. Weal: It seems to me that this rule makes the car owner responsible for damage to cars in ordinary service, or ordinary wear and tear, and this one strengthened the rules by giving us a chance to get a joint statement that the condition of the car at the present time is due to decayed parts. If the center sills are broken on account of being worn oblong, I claim that the statement should cover consequential damages.

Mr. Giblin: If you have two worn-out or decayed center sills, that have failed under ordinary service, they are car owner. It takes three parts to form a combination. My understanding would be then that we should have an additional sill broken new—two additional sills broken new, and you could charge the owners along with the worn-out sill. But when you have another sill broken it enters into a combination and you only get paid for the worn-out center sills. Under the new rules, when a car comes on the repair track and you apply a couple of new center sills and find a side sill that should be renewed, you are certainly supposed to take the side sill out also, unless the car is in such a condition that you should handle it under Rule 120. And that is why I claim that, regardless of the number of sills, it is the intention of the arbitration committee that we get cars on our repair tracks that we will not only repair the end sill and the center sills but will make all repairs necessary to keep car in good serviceable condition the same as if the car were our own. If your own car came on your track with center sills or door posts that needed renewing on account of wear

Messrs. Campbell, Fletcher and Wallace. Note the Shining Domes of Thought.

and decay, you would change them. That is just what they want us to do with the foreign car.

I believe Mr. O'Donnell says that this only refers to sills. I do not understand it that way. If you will read the footnote under Rule 42, it says when a combination of defects involves decayed parts. That does not say whether it is sills or what it is. If you have an end post broken new due to the load shifting, and you have got to renew that one end post and you have the two corner posts decayed, your joint evidence covers it just the same.

Mr. Kipp: Rule 1 is a good guide as far as this book of rules is concerned and if we all treated one another's cars as we treat our own we will not make expensive repairs to another fellow's cars, when if we had a car in the same condition we would dismantle it. I further believe that 42 gives us the right with two defective or worn-out draft sills, consequential demage to any of the other sills on the car needing repairs, the right to bill the owner if you get joint evidence, and that will be final. We would not do that if we followed the rules as we should—we would not do that to the same class of car that belonged to our railroad.

Mr. Lynch: It is my opinion that this Rule 42 simply applies to a combination of decayed parts or worn-out parts. When we have more parts worn out or decayed the car possibly will come under 120. I do not think that we can—unless the additional damage is the result of consequential damage caused by the original decayed parts—go any further than the combination in signing joint statement for decayed parts.

Mr. McMunn: It is true I am privileged to attend meetings of the arbitration committee, but I do not feel that I am authorized or justified in attempting to answer for them. There was some special reason for this note being placed under Rule 42, and I think if we stop to consider we will probably be able to reason out what that reason was. My impression is, there has been a great deal of correspondence back and forth during the past year about center sills being decayed, or bolt holes elongated entering into a combination. It seems that a car with short draft timbers would be decayed center sills or elongated bolt holes and they would pull out and damage the end sill and cause a new defect, and possibly damage the entire sill, or the side sill drop giving a combination. Some railroads seem to feel that not a case of unfair usage to a certain extent but that the car owner should be held responsible for the decayed parts of a car, or for the center sills and elongated bolt holes.

A number of organizations have called this matter to the attention of the arbitration committee and it would seem, in accordance with the action taken at the joint convention, that these complaints were in a measure justifiable. For that reason this note was placed under Rule 42.

Mr. Devaney has raised a point as to how the joint evidence statement would be prepared should he find the end sill broken new defects, two center sills decayed or elongated bolt holes, and two intermediate sills broken. In my opinion, all that would be necesary for him to do would be to get joint evidence statement indicating that you have two center sills decayed or elongated bolt holes; that would be authority to bill for the center sill. For the damage new involving a combination, if you had two longitudinal sills and an end sill, the balance of the repair card would be marked "No bill." If there wasn't a combination involved—if you had an end sill or two center sills decayed and a broken end sill or two center sills decayed and a broken end sill, you render bill for all of the damage.

Mr. Kipp: If the three parts were decayed?

Answer: Your joint evidence would be presented indicating decayed parts whatever it may happen to be. So long as the parts do not involve a combination you would render bill under joint evidence for the decayed parts.

Mr. Lynch: The two additional parts that are broken new enter into this combination, if not the result of the decayed or former condition of the car, could you then include it on a joint statement? If we have a combination of two center sills worn and an end sill broken, you say that you can include the two broken intermediate sills new. I claim that we cannot, unless it is the result of the original condition of the car. If it is not the result of the decayed parts—if the additional damage that is caused is not the result or is a consequence of the decayed parts, then I do not think that we could sign a joint statement.

Answer: Certainly not. I would say that you could not in case of derail, but where you have center sills decayed, or elongated bolt holes and the end sill pulled out, you will see at the time the draft sill is pulled off which is generally the time of this damage to intermediate sills to the car—in that case, it is my opinion that you

can bill for all the damage so long as the new parts involved do not form a combination. You are excluding entirely the decayed parts, or elongated parts, from your controversy. If you damaged two intermediate sills you would render bill to the car owner.

Mr. Lynch: You exclude entirely the decayed parts until it enters into a combination or beyond that. Suppose we have to handle that car in a chain to the repair track?

Mr. O'Donnell: As I understand what Mr. McMunn tells us, it sustains Mr. Hanson's idea; the decayed parts are redeemable by themselves, without any other parts. If in connection with the other parts you tear the tenents out of the inter sill, you can bill those two, but just as soon as you get three sills that goes out. Suppose there is a combination of three items that are decayed, or one of them is not decayed but they break, then you get into two more items for decayed parts, should those be shown separately on your joint evidence two inter sills show decay. Why shouldn't that come under Rule 120? You get $75.00 on that car if you go into four or five sills and the end and draft timbers.

Mr. McMunn: The inspector would have to use his judgment. It would be hard to get up a set of rules whereby they would be so clear to everybody that they would be beyond misinterpretation, or that there could not be a variance of opinion.

Mr. O'Donnell: I do not think that the remarks of Mr. McMunn should be taken in our minutes as authentic.

President Schultz: I believe that under this foot-note to Rule 41 and 42, if a decayed part exists and there are two broken parts in connection with those, it will be proper to bill the owner under these conditions. If there is a decayed part and there are three new broken parts, then we have got beyond and cannot bill all of those parts against the car owner, but will bill for the decayed parts.

Mr. McMunn: You can bill for all damage so long as you do not have a combination of new parts. You can bill for the two center sills, elongated bolt holes on the evidence as long as the new defects are not involved.

Mr. Kipp: If we have two center sills decayed we can bill for them under all conditions. If we have two intermediate sills and an end sill that has given out with them, then we can only bill, as I understand you for the two center sills.

Mr. McMunn: You are entirely right.

Mr. Lynch: Isn't there an arbitration decision where you have such a combination you cannot bill for the old, broken or decayed parts. When you have a combination of defects—any defective holes decayed or worn parts, you cannot bill for them. You must stand the cost of all the damage.

President Schultz: This present rule knocks the spots off of that decision. It will have no bearing on it whatever.

Mr. Lynch: Did I understand you to say that if you have a combination of decayed parts, two center sill or end sill, that you can sign joint evidence, but if you have a combination of new parts, we then cannot bill on that new combination?

Mr. McMunn: I will assume that you could bill for any part of the car. I believe it is the intention under the present rule to allow the handling company to bill for any damage to the car due to decay, provided you are covered by joint evidence statement to that effect. You will confine your no bill repair to the parts damaged new.

Mr. Devaney: It is my idea that the Master Car Builders intended that we should do that work and if the joint man sees there are other worn out parts he can tell us to repair them and give us authority to bill the car owner, and if there are one or two broken parts, add them in. Rule 1 and 2 makes it imperative, after Oct. 1, for us to repair the cars properly.

Mr. Dement: If we are going to do that just as soon as these two draft sills become worn out, or any part becomes decayed, we are going to make the repairs. We will take a case of the Chicago & Alton, if they receive a rush load at Chicago with two worn out draft sills and they wanted to rush the car on to St. Louis, and when it gets there there is an end sill broken, there is no reason in the world why the C. & A. should not pay for the end sill.

Mr. Hitch: I move that this association refer this matter to the arbitration committee, to draw a line between the two rules.

Vice-President Hanson: I hardly believe we ought to do as Mr. Hitch says for the reason that I believe the M. C. B. Association feels that they cannot set a line. It will have to be left to a certain extent to the judgment of the party who has the car in his possession as to whether you are justified in having a joint statement signed and go ahead and repair the car under Rule 42, or whether the general condition of the car warrants you in taking it up with the owner under Rule 120.

I move you that it is the sense of this meeting that under Footnote 41 and 42 of the rules involving combinations, that by having a joint statement signed and sent to the car owner with the bill, that we can bill for all repairs which are owners' defects, so long as there is no combination which involves all new defects. That will take in any additional sills that might be necessary, or any other repairs necessary on the car that are due to worn out condition. I do not believe we can confine ourselves to this referring simply to sills, because it should cover any repairs necessary on the car, so long as there is no combination of new parts.

Mr. Boutet: I would ask Mr. Hanson to separate his motion, if agreeable to him. It is rather long. On the first part you said all parts of the car that do not form a combination are chargeable to the owner. I hardly think it is fair to the car owner. While I believe it is proper to sign joint evidence, I do not think it is fair, simply because we get a car with two draw sills broken worn out, elongated bolt holes, end sill broken, you have two inter sills that are broken, they are partly decayed on top—I do not believe it is fair to sign joint evidence for that. If you confined your decayed parts, if not broken, I would be with you.

Vice-President Hanson: The reason I brought in the last part of the rule is that if you get an end sill broken new, two center sills worn out or split on account of holes elongated, that takes care of that feature. I want to go further: We may have three end posts broken new and another end post that is decayed. Under the present rules if we go ahead and make repairs and send the bill to the owner under these conditions they will, in 99 cases out of 100, say there must have been rough usage. In order to avoid delays to these cars, in a good many cases we go ahead and make the repairs and take a chance on satisfying the owner. Some cases they O. K. the bills and in some cases they say they are not justified. That is the reason I feel that when you have a joint statement signed, showing the general condition of the car, so long as you do not have a combination involving all new parts, that you are justified in billing for all, whether it is a center sill, end post, or what it is.

Mr. McMunn: If the joint inspector will consider that the car owner is responsible for the decayed condition of the car or the elongation of the bolt holes, and that the delivering line is also entitled to some consideration, there should not be much further need for argument as I understand it; the joint inspection statement should cover the defects on that car. When there is a combination of defects involved, we will exclude that from the controversy entirely; then let the car owner settle for the delivering company defects the same as they do now under the rule. We simply confine our joint inspection statement to the decayed parts on the car. It is not necessary to include all the defects existing. The handling line is responsible for certain defects and the owner is responsible for certain defects. The delivering line or the handling company is responsible under the rule. These defects are covered in Rules 37, 42, I believe, and the owner will settle on the basis.

Mr. Trapnell: I believe we should get right down to business and not undertake to practice sharp practices on the car owner, and if the absolute condition is reported to the car owner, the delivering line will have but little trouble in collecting their bills.

The remarks that I made yesterday will come out and be in conjunction with the remarks made now. We should at all times remember that the car owner is entitled to fair representation on the committee that accepts that car, and that we, as men, give the car owner all that he is entitled to.

I move the previous question. It will be necessary to revise the motion. All that we ought to do is to vote on the sense of the motion.

The question was put upon the motion and carried.

Mr. O'Donnell: There were three other rules, the demolition of trucks and the new rule on steps and grabirons. It was brought out that we are now charging bent sill steps hand-holds and grabirons to the owner; after the new rule is brought out that all of these items come under the category of delivering line defects. We think that if that is brought out that it would eliminate all items to be charged to the owner. Under Rule 33, could they be charged to the car owner?

Mr. McMunn: As I understand it, you will not be able to render a bill for any defects to safety appliances, regardless of how they have occurred. You will not be able to render a bill to the owner after July 1, 1916. All cars must be equipped with safety appliances or safety appliance standards. In order to maintain these standards, I believe it is felt that the delivering company shall be held responsible for all defects arising; that a car with safety appliance defects cannot be offered in interchange. It seems at the present time that the existing rule is being abused. Some railroad companies are making bills for all sorts of safety appliances, and in order to tie the things up—to make the rule more binding, it was felt that the handling company should be responsible for all these parts. The thing is reciprocal. There are two evils and it seemed to be the opinion that the rule will more clearly meet with the conditions.

Mr. Hall: Under Rule 115, I wanted to know how we could settle for trucks to cars of 50,000 capacity or less. What rule could I apply if I have a railroad company's car on my line and it is destroyed and the trucks are destroyed; could I settle for those trucks at scrap value, or am I compelled to settle under the rule for depreciated value? Calling attention to the last paragraph, does it apply to trucks of individual ownership? I want to know who individual ownership is and how I can settle.

Mr. O'Donnell: We take the stand that if you read the first paragraph of the rule and stop, you understand it. The second paragraph simply releases the trunk lines and railroad-owned cars or paying or participating in something that the private lines could not get any reciprocal offset on.

Mr. Kipp: It seems to be the opinion of some of the members of the association that private line cars, or individual ownership cars, escape the scrap question in this rule. My contention is that any party to these rules, whether a railroad company or a private line company, is bound by these rules. And any railroad company or private line company that is not a party to these rules, gets into this exception.

Mr. McMunn: I believe I can explain why that rule was formed as it is. At the present time railroad companies as a general proposition are scrapping trucks of all cars of 50,000 capacity; in fact, have very few trucks under cars of less than 60,000 capacity. The cars of private ownership, refrigerator cars, tank cars, etc., as a general proposition their capacity is from 20 to 30 tons. It would be an injustice to take trucks of these cars and scrap them for the reason that these people do not require cars of that capacity. They have no use for a 40 or 50,000 capacity truck, but the railroad companies have. They have been carrying trucks of this lighter capacity and when they would get them home they would scrap them. The proposition was different with the private lines, and for that reason it was felt that there should be an exception made to cars of private ownership.

Mr. Kipp: I would like to ask Mr. McMunn how he gets around Rule 129 in that respect that says any car owner that is a party to these rules.

Mr. McMunn: I would simply answer by saying that we are now referring to a part of the rule and that is a part of the rule and they are guided by it.

Mr. Hall: If I had a private line car, or a stock car belonging to a private stock car line, and they were members of the M. C. B., and I destroyed the car and destroyed the trucks, how can I settle, at the depreciated value or at scrap value, for trucks of 50,000 capacity?

President Schultz: You should settle for depreciated value.

Mr. Hall: If the party that the trucks belonged to was not a member of the M. C. B. and the trucks were 50,000 capacity or less, I would settle and comply with the rule on scrap value; is that right?

Mr. McMunn: If it wasn't a member you would have to settle with yourselves; the M. C. B. would not attempt to legislate.

Mr. Hall: I understand that that is the interpretation of the rule. I would like to refer back to Rule 17, paragraph e. I realize that we have a circular on what is a standard brake beam, but we have two ways of testing these beams. If I get a car that is equipped with a truss beam and I apply a solid beam. In one way it is as strong, the solid beam is as strong as the truss beam on a transverse test, but the truss beam is stronger on the direct test. Which test is right?

Mr. McMunn: I think the proper committee to answer that would be the M. C. B. committee on brake beams.

Mr. Boutet: I have been asked to bring up Rule 21 as to whether it gives a way of applying temporary hand rails on cars with running boards without roofs; as to whether a car without a roof and with a running board, without hand rail, is a defective car.

Mr. Boutet: At the meeting in October the question was asked by me, if a railroad company could embargo a car. The committee

Members and Guests of the C. I. C. I. and C. F. Association at Coney Island.

Continuation of the Upper Illustration.

answered in Circular 18 and said that no embargo can be issued. It involves the construction of the car. Rule 21 says you can apply if the car is a bad order car. I claim no transfer should be given.

Mr. O'Donnell: We agree that all of these running boards were being removed by the owners of the car, permitting the train men to go up and down the rack. If, for any reason, the car under load, it is just as safe as if there is a roof on the car, but when she is returning empty, if the delivering line or intermediate line wants to take exceptions, I think the owner would pay for applying the hand rail, rather than lose the running board appliances. They are not fit for the train men when empty, but when loaded they are just as good.

Mr. Stoll: The M. C. B. says you must place there a temporary running board and hand rail to prevent the train men falling down in the car.

Vice-President Hanson: We raised this question two or three years ago. At that time we were getting a lot of box cars from the South, loaded with ties with no roofs, and the question came up as to whether we would be justified in holding up these cars, refusing or transferring them, or placing temporary running boards with hand railings and billing the owner. We had instructions to take no exceptions to them as we had no right to refuse them, and if we saw fit to put running boards and hand rails on in returning, the handling line would pay for it. There was no inducement for the train men to go over the car, and we paid no attention to them and are running them that way today.

Mr. Stoll: I rise to a point of information. Going through these rules, you omitted A. R. A. car service, Rule 15, in which there has been a change made, as I understand it. They have added paragraph a, of car service rule, when transfer is due to defective equipment and is not safe to run, according to M. C. B. rules, unless the repairs can be made under load, page 112. Why was that omitted from these rules?

President Schultz: I am familiar with why it was not put in the rules last year. The arbitration committee thought it was too broad and they omitted it. I cannot see why it was omitted this year. The rule, as adopted by the association, does not read as it was put in.

Mr. O'Donnell: It is just as good. No line is going to pay any money for transfer if you can repair the car under load. If you cannot repair the car under load, you have got to penalize them.

Mr. Trapnell: How do you account for the repair of the arch-bar? I believe that we should arrive at some concrete opinion among ourselves, so that we can place it in the form of a motion, that the officers of the C. I. C. I. & C. F. would be in a position to take the matter up with the arbitration committee and also a committee of the A. R. A. who have the information and enforce A. R. A. Rule 15, and call their attention to the various amount of difference that exists in this country relative to this rule, especially with the top of the rule, which says, "unless otherwise agreed." We have shown up to them the conditions that exist. One place 10 hours, one place 24, and another place 18 hours' labor necessary to repair that car and ask them to give us a positive ruling on what is necessary and cut out this "unless otherwise provided." You will find that two companies get into a wrangle, it makes no difference how simple the defects are, they say the receiving line is the judge, and if they want to transfer the car the delivering line has to pay the bill. Let us get some interpretation on this rule that will put it into shape that it cannot be repaired under load and no hardship will be worked on any line. In 287 miles of Kansas City, it says no transfer shall be given for a combination unless it exists 24 hours.

Mr. Lynch: If I remember right, this was discussed before the arbitration committee last October, and the A. R. A. knew it was brought out by the chief joint inspectors. I think the arbitration committee omitted it this year because of the fact that a great number of commodities are not transferable, and if a car is held up for 36 hours, justified in repairing and cheaper than to transfer, and have a loss to the contents. I think that it would be a matter for the handling lines or the chief joint inspectors to decide, as to

whether you can transfer a car or stand the chance of having a claim for damages. I think it would be wise to place a limit of time for transfer. On certain commodities, such as glassware, which is liable to be damaged, the expense of transfer is small as compared with the claim that comes in for damage. I think it was left out for that reason.

Vice-President Hanson: There is a time limit set on any car that cannot be repaired under a certain number of hours, according to what the car is loaded with. On a carload preferred freight, 24 hours; if coal or coke, 5 days, and other freight, I believe, 72 hours.

President Schultz: In Chicago we started to carry out the rule as framed by the A. R. A., that transfer orders will not be given for cars that can be repaired under load, and we found it necessary to modify it in regard to broken metal truck bolster. When it is broken on owner's car coming home, we do not give transfer order. We do not expect anybody to splice sills under a loaded car unless it be a commodity where the load does not interfere with the work.

Mr. Trapnell: I move you that this association recommend to the proper committee to make Rule 15 uniform by cutting out "unless otherwise agreed," and state that any car that cannot be repaired under load is the only car that transfer should be given for.

Mr. Devaney: I know that the same question was before the arbitration committee last summer. Just as the motion reads. You can transfer unless it can be repaired under load. We tried in St. Louis every rule known to man on transfer, and none will satisfy all, and I believe, from my view, if the interchange inspectors cannot interpret this rule, we will have the same trouble with a general transfer rules. I think every locality will have to take care of itself.

The motion was lost.

The following communication was read:

We, as your committee, appointed to draw up a resolution for the recommending to the M. C. B. Association, the adopting of a M. C. B. standard steam hose coupling. We find in the proceedings of the M. C. B. Association, Vol. 47, Part No. 1, page 518 of the 1913 proceedings, that the M. C. B. Association have recommended a steam hose coupling as a recommended practice. We suggested that this association make recommendation to the M. C. B. Association, that this steam hose coupling as a recommended practice, be adopted as an M. C. B. standard, adding to it a standard locking device, so that all steam hose couplings may be properly locked when coupled, so as to be interchangeable.

J. J. GAINEY,
C. M. HITCH,
A. KIPP.

Mr. O'Donnell: I move that the report be accepted and the recommendation in the rule by the executive committee be passed on to the Master Car Builders.

Seconded and carried.

Mr. Trapnell read the report of the executive committee as follows:

The executive committee met in the mid-winter session and recommended to the arbitration committee the necessary changes in the rules, which you will find a large number have been incorporated in the rules.

Your committee also has audited the books of the secretary-treasurer and find the same correct as follows:

Balance on hand at last audit	$ 22.19
Received in general fund from members	585.10
	$607.29
Paid out during the year	576.10
	$ 31.19

And your committee further reports that they have received invitations from the following cities inviting this association to hold their next annual convention with them: St. Louis, Atlantic City, Detroit, San Francisco, Buffalo, Galveston, Niagara Falls, Ontario, and Chicago, Ill.

Your committee recommends that this be referred to the incoming executive committee for their advice and decision.

We further recommend that the secretary-treasurer be authorized to procure a past president's badge for each retiring president, the badge to be of standard design as heretofore procured.

We further recommend that the secretary be instructed to secure a large ledger to keep the actual standing of all membership.

We further recommend that a committee of three be appointed to revise the constitution to report at the next meeting.

Committee: F. W. Trapnell (chairman), A. Kipp, J. P. Carney, C. J. Stroke, J. J. Devaney, E. R. Campbell, W. R. McMunn, J. W. Stoll.

Mr. Trapnell moved that the report be adopted. Seconded by Mr. Boutet and carried.

Mr. O'Donnell spoke in favor of holding the next convention at Niagara Falls on the Canadian side.

Mr. Leroy Wright: The duty of the entertainment committee is to supply amusement during the unoccupied hours for the members and doing all we possibly can for their families. Sometimes it is a pretty big job, and sometimes it is small. I have always enjoyed it. I do not think it is out of order at all for me to read the names of the supply concerns who have without question entered into the supplying of the funds which gave us the opportunity of supplying our entertainment this year. They are as follows:

American Steel Foundries.	
Armour & Co.	Joyce-Kridland Co.
American Brake Shoe & Foundry Co.	McConway & Torley Co.
	W. H. Miner.
Acme Supply Co.	McCord & Co.
Bettendorf Co.	National Malleable Castings Co.
Boss Nut Co.	W. P. Neikirk.
Camel Co.	Procter & Gamble.
Chicago-Cleveland Car Roofing Co.	Standard Heat & Ventilation Co.
Cincinnati Chamber of Commerce.	Standard Car Truck Co.
Curtain Supply Co.	T. H. Symington Co.
Grip Nut Co.	Swift & Co.
Galena Signal Oil Co.	Union Draft Gear Co.
Hewitt Supply Co.	West Disinfecting Co.
Hale & Kilburn Co.	Westinghouse Air Brake Co.

Those firms have furnished us the finances for your entertainment at this convention, with the exception of the amount which we turned in to the secretary as being the surplus on last year's entertainment.

I cannot say too much for what we have received in Cincinnati. In trying to elaborate on the things we have done, you might think we could have been more entertaining, but when we start out with the various things that we can do and the money we have to do them with, it is something to select the things that will best occupy our time. We cannot always get the concessions that we have received here, and we have done probably more than any other place for the money it has cost the entertainment committee. It is due to the effort put forth by the local people here who had this absolutely laid out for us in such a manner that all we would have to say would be that we have the money for it and pick out the ones that seemed best. I cannot say too much for the assistance that we have received along this line.

Election of Officers.

The following officers were elected for the coming year: President, F. H. Hanson, L. S. & M. S., Collinwood, O.; vice-president, A. Kipp, N. Y. O. & W., Middletown, N. Y.; secretary-treasurer, Stephen Skidmore, 6th and Millcreek, Cincinnati, O. J. P. Carney and W. J. Stoll were re-elected members of the executive committee for two years. William Hansen was elected a member of the executive committee to fill the unexpired term of A. Kipp (elected vice-president), and C. W. Maddox was elected to fill the fourth vacancy on the committee.

President Hanson: It has been my pleasure to serve this association for two years as a member of the executive committee and one year as vice-president. You have now elected me your president, which to me means that you have confidence in me. In order for me to make a success in the office it will be necessary for me to have the hearty co-operation of every member, and I feel that I will have this the same as you have given my predecessors. I appreciate the honor very much. At this time I wish to say I feel that we have not tried to increase the membership as we ought to. While I have obtained a few members the past year, I am still satisfied that if I had given more attention to this matter I could have done more. I am going to ask that each one bring in at least one new member and as many more as possible within the next year. As we have a meeting some place during the year, in addition to this annual meeting, where we get together and have a more uniform understanding of the rules, and especially the changes, at which time the executive committee gets together and considers recommendations and changes of the rules, the new features that we inaugurated last year; that instead of having only the executive committee get together on that occasion we would also notify all members and have as many come to that meeting as possible; it would be beneficial. I believe that is a move in the right direction, and I also believe that at our next executive meeting we will have a large representation of the members. I hope that we will come at that time prepared to discuss any changes that we may wish to recommend to the M. C. B. Association the following June. I want again to thank you for the honor that you have bestowed upon me in electing me your president, and I hope that you will have no occasion to regret it. (Applause.)

Mr. O'Donnell: I move that we extend the thanks of this association through its officers and membership to his honor, Mayor Spiegel, for his excellent address, and to the municipality of Cincinnati for the generous and kind treatment it has given us during our sojourn here.

To the excellent gentlemen of the entertainment committee who have labored so zealously for the social success of this convention.

To the ladies of Cincinnati for the splendid manner in which they have taken care of our good ladies from a distance.

To the management of the Hotel Sinton for the generous and courteous treatment they have accorded us all the while we have been under the dome of this beautiful building.

To the president and his associate officers for the manner in which they have conducted this meeting and the patience they have exhibited during the many trying moments of the association.

We are leaving the association today with two of our old-time members retiring from office, Mr. Trapnell and Mr. Campbell. I am sure I encroach upon the liberty of no one when I say that the association will part with them with much regret, and we hope that they will stay with us and give us the best they have.

We are further grateful to the trade journals, the Railway Master Mechanic and the Railway Age Gazette, for their aid and co-operation, for all of which I ask a rising vote of thanks.

Mr. Lynch: I would like to amend the motion so as to include Miss Unkenholz, who has been very patient with us.

The motion was seconded and unanimously carried.

And thereupon the convention adjourned to meet in 1915 at the call of the executive committee.

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RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S. MYERS, Vice-Pres. — L. F. WILSON, V. P. & Editorial Director
C. C. ZIMMERMAN, Bus. Mgr. — OWEN W. MIDDLETON, Editor
DALTON RISLEY, West. Mgr. — W. A. D. SHORT, Editor

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

This Publication has a larger circulation than any other among mechanical department officers. Of this issue 4,500 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIX Chicago, October, 1914 No. 10

CONTENTS.

To the Railway Officer

It isn't necessary to inform you that we are passing through one of the most trying periods of our railway history. The exorbitant demands of employes whose organizations are taking every advantage of certain political trends, added to the dilatory tactics and confiscatory rulings of law makers and commissions, topped by a financial condition which has caused concern among those better favored, has forced you to cut expenses where such cuts are not economical. You are unable to take advantage of opportunities to put into effect plans for improvements in methods and equipment which would be money savers from the start, simply because they call for an initial outlay.

Realizing that these conditions *must* change, the more reliable, solidly grounded supply manufacturers are going ahead in the development of new devices and methods and in the improvement of the old. They are not bothering you by insisting that you buy large amounts of equipment and supplies, for they know that you are helpless, but they do need your moral support if they are to go ahead in the improvement of the art. Most of you are lending that support and deserve credit for that assistance.

Sometime you will have to buy, and in large quantities. Had conditions continued prosperous without cessation, improvement in all devices and equipment would have kept pace. Upon the return of prosperity none of you wish to begin where you left off and you will not have to begin there with most of the manufacturers whom you have found to be the most progressive in the past, because they have, undaunted by conditions and discouragement, increased the efficiency of their various details of equipment expecting your moral support now and a more tangible species of support later. It is therefore your duty owing to the art of American railroading, that you see each supply representative who has legitimate reason for his call and that you give his proposition the consideration it deserves and the study it requires.

To the Railway Supply Manufacturer

In times of prosperity your representatives have waited outside the offices of railway officers for hours and days, hoping for the opportunity to present arguments for the sale and standard adoption of devices and methods which you have carefully worked out at considerable expense of time and labor. You have sometimes found it impossible to obtain opportunity to demonstrate superiority which you knew you possessed because the officer you must reach was too busy to give it the proper attention, and because he did not dare initiate a movement which might handicap him in keeping every piece of equipment in service in supplying the demands of traffic.

A return to conditions of ultra-prosperity is inevitable, the longer the return is postponed the more marked will be the improvement. We are sincere in our remarks addressed to the railway officers, as above, and we believe that you are not laying down in discouragement because actual orders are small and infrequent, or because you infer that your efforts in the development of improvement are not appreciated. We believe it is up to you to bend every effort at this time to inform every interested railway officer in the country of your activity in new economy-producing and labor-saving devices. We believe that you have better opportunity at the present time for securing the attention and consideration of those who will, later, taking advantage of what you now show them, base their recommendations for future purchases upon

what you now teach them, than you will ever have again.

The conclusion is obvious: If you have an improvement which does not require additional outlay on the part of the railway, visit the railway officer with the hope of securing immediate orders; but if your proposition does require initial outlay, visit him with the idea of securing his approval and therefore his guarantee of recommendation at the proper time.

Traveling Engineers' Convention

Elsewhere in this issue will be found a report of the twenty-second annual convention of the Traveling Engineers' Association, recently held at Chicago. This association has for its motto "to improve the locomotive engine service of American railroads," and it can be truly said that it is living up to that motto. It is noted for the value of the subjects which it chooses and for the time which it gives to their discussion; in fact, it can be safely said that it puts in more working hours at its sessions than any one other mechanical association. The discussions are practical and to the point. They are so specific that the members can go home and put the new ideas which they have gained into practical operation. As indicative of the way in which the association is regarded, it will be noticed in the report that there was an addition of 130 new members during the four days of the convention.

The attendance and attention given to the lecture on the chemistry of combustion by A. G. Kinyon was also very significant. It shows that the members are getting down to the scientific explanation of proper combustion and are studying the matter carefully in order to find out how to get every ounce of energy possible out of the coal. That is the problem on American locomotives today—to transform the heat units of the coal into power with as little loss as possible. That is a part of the work to which the Traveling Engineers' Association is dedicated and it is doing it well.

Grinding Wheel Safety

A mass of brittle material moving at the rate of a mile a minute is certainly capable of causing great damage and it would seem that such a mechanism would be one of the first propositions to be looked into in a "Safety First" movement. Unfortunately grinding wheels have not always been given the attention they should. The grinding wheel is a necessary adjunct to every shop and is a piece of apparatus which many shop men have to make use of. There is nothing complicated about it. It runs along smoothly and the average man has little conception of the tremendous amount of energy which that swiftly moving mass represents. So not a great deal of attention is paid to it until some day something happens which brings a realization of the danger involved.

The manufacturers of grinding wheels are fully alive to the responsibility which rests upon them to make wheels which will stand the strain to which they are to be subjected. Every wheel is carefully tested at considerably higher speeds than will be required of it in the shop and a complete record of each wheel is kept on file. However, there are many ways in which even perfect wheels may be damaged and broken, such as imperfect mounting, running at too high a speed, overheating the wheel by heavy grinding, improper adjustment of the work rest or as the result of being struck by a heavy casting. Shop men should be fully informed as to what is bad practice in grinding wheel operation, but even at that carelessness cannot be entirely eliminated and the only way to be absolutely safe is to provide protection even if the wheel does break.

The grinding wheels placed on the market today by the manufacturers are quite fully provided with protection hoods, but where there is need for work is on the many old grinding wheels which are to be found in every shop and which are often inadequately equipped with band or other protection devices. There is, it is true, considerable divergence in opinions as to the design and strength of band protection devices and safety engineers and manufacturers should be able to get together and make some conclusive tests along this line.

The breakage of the wheel is not the only danger to the operator of the grinding wheel, for small particles, by flying off and striking the eye, may—indeed, in some cases, do more damage to the operator than a larger piece might. So it is highly important that the operator who does any grinding on rough castings, etc., should be provided with goggles, which will protect the most valuable and sensitive portion of his body from injury. The loss of eyesight, the loss of the ability to comprehend the world in which he lives, is the greatest misfortune which can befall a man. Fortunately, the use of protection devices for the eyes of workmen has been extended rapidly. Their value is self-evident and cannot be questioned. But there are many old grinding wheels throughout the country which need better protection. That grinding wheel may break today.

THE RAILWAY RATE CASE.

The decision of the Interstate Commerce Commission in the five per cent rate increase case comes far from solving the problem of American railroads. The increase granted will bring some additional income to the railroads operating within the favored territory, but the income thus gained will not be sufficient to offset the ever-rising cost of operation, nor will it be of such magnitude that the investing public will be guaranteed fair return on railroad securities.

After having the petition of 112 eastern railroads, embraced in what is known as Official Classification Territory, asking for a flat five per cent increase in freight rates under advisement for more than a year, the Interstate Commerce Commission handed down its decision. An increase of five per cent on sixty-five per cent of the freight traffic was allowed to those roads within the Central Freight Association Territory. This in itself constitutes a moral victory for the railroads and gives promises of better treatment at the hands of the Commission in the future, since it is a practical reversion from the popular restrictive policy pursued by the Commerce Commission since its establishment. It partly carries out the assurances of the railroads in 1912 by Chairman Prouty of the Commission that if the time comes when it will be necessary to allow some increases in transportation charges it will be the duty of the Commission to permit that advance.

The attitude of the public and the Government must be changed from suspicion and distrust to confidence and liberality.

If the investing public is not assured of a fair return on railroad securities, new capital will not be forthcoming and the railroads of the country will be unable to make improvements necessary to handle constantly increasing traffic. Either rates must go up or wages which have been repeatedly raised by successive arbitrations with labor unions, must come down. An industry cannot be oppressed beyond the point where it is profitable.

In 1900, it cost the carriers 64.62 cents in operating expenses to get one dollar in revenue. In 1913, the carriers were forced to expend 71.77 cents to obtain one dollar in revenue. Cost of operation had gone up and rates had come down. If the cost of operation had remained permanent in 1900 the revenue of the petitioning carriers in 1913 would have been $100,000,000 more than it was.—*American Industries.*

Twenty Years Ago This Month

(From the Files.)

William L. Bull, of New York City, has been elected president of the Minneapolis & St. Louis.

Orlando Stewart, formerly superintendent of motive power of the Fitchburg Road, has been appointed superintendent of motive power and machinery of the Bangor & Aroostook, with headquarters at Oldtown, Me. Mr. Stewart has been for many years one of the leading mechanical railroad officials of New England and a prominent member of the New England railroad clubs, before which he has read many important and interesting papers. He is treasurer of the American Railway Master Mechanics' Association. The Bangor & Aroostook now operates nearly 200 miles of road and about 60 will be completed this fall. Mr. Stewart expects to erect new shops for the company next spring.

George B. Harper, general superintendent of the Kentucky Midland, is now operating that road as receiver.

J. C. Doughty, a locomotive engineman on the Truckee division of the Southern Pacific, has been nominated by the Republicans of Nevada as their candidate for congressman.

James Maglenn has been appointed superintendent of motive power of the Seaboard Air Line. This is another step in the concentration of the management of the roads operated under this organization. It has been previously marked by the appointment of a general manager and the abolishing of the division superintendencies. Heretofore the mechanical department of each of the roads included in the route has been in charge of the master mechanic. Mr. Maglenn has held the office for nearly 20 years on the Carolina Central. His headquarters have been at Laurinburgh, N. C., but under the new order will be removed to Raleigh.

John S. McCrum, superintendent of motive power and machinery of the Kansas City, Fort Scott & Memphis at Kansas City, has resumed his official duties after an absence of a year on account of poor health.

S. J. Morris has resigned as general foreman of the Louisville & Nashville shops at New Orleans to accept a position in the Western of Alabama.

J. D. Begg, who has for a number of years been a machinist in the shops of the Columbus, Hocking Valley & Toledo at Columbus, O., has been appointed master mechanic of the Southern Pacific at Houston, Tex.

John Henney, Jr., superintendent of motive power of the New Haven system of the New York, New Haven & Hartford, has also been appointed superintendent motive power of the Old Colony system to succeed James N. Lauder, deceased. Headquarters Boston, Mass.

MATERIAL TO WEAR OUT, BUT NONE TO RUST OUT.

General storekeeper Gerber, of the Southern Railway, announces that the slogan on the Southern is "All the material you want to wear out, but none to rust out." This, we think very appropriate and would look well stuck upon our fence posts, section house doors and other outbuildings around stations along with "Safety First" signs. At least it should hold a very close position to the "Safety First."

"Plenty of Material to Wear Out, But None to Rust Out." Let us take up Mr. Gerber's idea on this and push it. Send it out to all the storekeepers at local points; send it to the car foreman; ask them to look around and see what material they have, be it one pound or ten that have three or four sheets of rust on it; ask them to send it in; get it into the field where it is needed or scrap it.

Eight or ten years before the organization of the Railway Storekeepers' Association, the excuse was often made that "Sometimes I am going to want that; once in my life I was called on." With a live set of storekeepers nowadays those conditions do not exist.

We know of a case at a junction round house where a tramp engine was sent to this round house for minor repairs. The round-house foreman, of course, did not have any repairs peculiar to that engine and he scurried around and got from the home company the necessary stuff, and then to protect himself should another occasion occur, he ordered a duplicate of the cylinder head, bull ring, etc., which happened to be the parts needed, and carried them in his local storehouse for nine years; or rather they were still on hand when he was pensioned. Of course that tramp engine never came that way again and the probabilities are that that class has long been made obsolete.

As our traveling storekeepers go over the road, following Mr. Gerber's plan, let them communicate with the car repair foreman who at some time had received a foreign car, for which he did not have an exact center plate, etc., but in order to avoid future occurrences has ordered in and carried the particular casting until you can scrape off four or five layers of rust with a penknife. Camp out with that fellow until you get him to see the right way to do things.

The managements realize that delays are bad, but they are more willing and offer less criticism when delayed than in former years, simply because they have got to contend with the human element, and every railroad as yet at least is bound to have some delays.

"None to Rust Out" applies equally to the "None to Rot Out," and we have thousands of dollars' worth of material that rots. Let us go through our lumber yard or inspection point where car repairers maintain dead woods, peculiar to foreign cars. See if we cannot find some that have been on hand so long that a bolt or nut would pull through them if they were properly fastened.

Six months ago if our management had to come out and told us that we would be operating our departments as we are today, we would have thought it impossible. How much further we have got to go, is hard to tell. Let us be prepared, however, to go the limit and be loyal to those we are representing. Fair and square with a fellow, who is up against it for material. Do not cut requisitions unfairly, but follow the conditions at the point where the material is called for, and we will meet with a hearty pat on the back from the fellows who are worrying over the financial end of the companies employing us.—*Railway Storekeeper.*

USE OF POWDERED FUEL.

Fuel economy and the intimately associated problem of smoke abatement are receiving much attention. Among the methods discussed, none, perhaps, is of greater interest than the burning of powdered coal. The experiments made in this direction are of especial value to all who are interested in the utilization of peat. The work done by Lieutenant Ekelund in Sweden, according to the Journal of the Canadian Peat Society, has already demonstrated that peat has very great possibilities when used in powdered form. Its composition and physical properties make it in some respects superior to coal for this purpose.

The requirements for best results in burning powdered coal are thus stated by an authority—

1. Coal must be dried to contain not over 1% of moisture.
2. It must be pulverized to a high degree of fineness.
3. It must be projected into a chamber hot enough to cause instant ignition.
4. It must be supplied with sufficient air for complete combustion.

The standard of fineness given by the same authority is: 90% through a 400-mesh screen; 2½ to 5% through a 200-mesh screen, and the balance through a 100-mesh screen.

It must be kept in mind that there is present in powdered fuel a certain percentage of extremely fine material, depending on the character of the fuel, its moisture content, and method of pulverization. The character of the flame is materially influenced by this impalpable dust, which gasifies instantaneously.

The physical structure of peat is such that a large percentage of very fine powder would be more easily obtainable than in the case of coal, thereby increasing the rapidity of combustion.

Another point in favor of peat powder is the usual high content of volatile matters in peat. There is much divergence of

opinion as to the amount of volatile matter required in coal to render it suitable for burning as powdered fuel. The majority of writers seem to think that 30% of volatile matter is a prerequisite, but some report satisfactory conditions with but 20%. The higher the volatile, the larger amount of the combustible will be converted into gas by the mere application of heat, and the more rapid and perfect the combustion. Ontario peats examined contain as high as 60 to 70% volatile matter, and should produce a highly efficient powdered fuel.

As in the production of peat fuel generally, the important question is the removal of the moisture at such cost as to render the fuel economical.—*Mechanical World.*

SPECIALIZING ON SAFETY FIRST.*

By P. L. Kendall, M. C. B. Clerk, Galveston, Texas.

Negligence produces injuries. But what produces negligence? I believe the greatest producer of negligence is that inclination of some employes to hold the "Safety First" organization as something new, an agitation, or as being the exaggeration of their accustomed easy-going way.

This class may concede the value of safety, in a general sense, yet they never have pondered the question sufficiently to make themselves sure that they need such an organization, and consequently they do not heed its teachings. This failure to heed is but a tacit acknowledgment that they do not even believe what they continually are being told aboout safety, as, if one believes a report, he will put that belief into execution, whereas, if he does not believe it, he will not heed it, excepting by coercion. We must get this erroneous idea out of our heads and understand that the "Safety First" movement is a present-day necessity, discreetly up to date and amply justified by circumstances.

The safety propaganda itself, of course, is of recent origin, but the fundamental principle it is endeavoring to inculcate is old and well recognized. We always have appreciated safety, applicable to everyday life, but when we meet it in its systematic and modern stage some of us fail to recognize it as quickly as we should. Until recent years we became so engrossed with the persistent sweep of industrial progress that we gave little thought to safety, which of necessity lulled. During this period the strength of safety was the individual, and, like all other things handled individually, its strength was small.

Finally we were aroused by the mutilating effects of such laxity, and, with a spirit of alleviation, we set about to establish safety. Then we found that hazards had well outgrown our old single-handed ideas, and it was necessary to organize and combat these conditions in a modern way. When this was done some were inclined to look upon it as a thing entirely new, when in reality it was only the resuscitation and broadening of our old dwarfed views.

Ours is a day of specialism. This is true in every branch of industry and profession, and perhaps is not more readily observed than in the medical profession. We all remember the physician who was eye, heart, stomach, liver—in fact, filling the place of a dozen specialists. This was necessary, and is today in certain districts, as conditions did not, and do not, demand these several specialists, while in other localities they are indispensible to good results.

And we must have the safety specialists. The same rules that govern the medical profession govern safety, from a viewpoint of specialism, only we are not so cognizant of it. There was a day when we did not need organized efforts to combat hazards and we do not now in all branches of industry, but there are other branches in which we must have them to secure the good results we have a right to expect.

It is an undeniable fact that public utilities are fraught with perils to a more or less extent; this despite the fact that machinery is being manufactured at present with a view to safety.

It is with machinery that men are injured, and, when the use of such machinery is increased, there will be a corresponding increase in personal injury liabilities, unless they are reduced by an actuating sense of safety. Every machine added to a shop, every car coupled to a train and every mile of track added to a road increases the probabilities of personal injury. And so, as we build larger locomotives, pull longer trains and increase facilities in general, we must also increase our foresight or safety or suffer the irreparable consequences. As there has been such a tremendous development along these lines of recent years we think the need for safety specialists is extremely urgent, yet no more so than the need for employes getting a proper conception of the reality of this organization, which conception will naturally beget coöperation.

The sooner we get it fixed in our heads that "Safety First" is not redtapism, the better it will be for us. Anyone looking upon it as such is merely advertising his gross ignorance of the altruistic motives of this great body, yet noticeable negligence is good evidence that there is too much of this expensive advertising being done. We must, sooner or later, learn that "Safety First" is founded on a no less reality than human life, and that it is conducted in a conservative, sensible manner, and that to give it unreserved coöperation is an indication of wisdom. By the application of specialism to safety we have shown that we are getting as business-like in dealing with this all-important phase of railroad management as with the material or financial side of it.

We need to specialize on safety until every avoidable accident will have been avoided, and then we need to specialize on safety to keep them avoided. While we have made some good advancement yet present preventable injuries are irrefutable evidence of space for even greater expansion.

Let us look upon "Safety First" not as something new but as the new combination of two old and approved elements, viz., safety and specialism. The remedy is a good one and the need is obvious.

"Safety First" means human conservation—it means living!
—*The Santa Fe Magazine.*

* From an article in *The Santa Fe Magazine.*

THE TRUE ROMANCE.

By Berton Braley.

"Romance is dead?"—the foreman smiled
As he would at the words of a foolish child,
"'Romance is dead?' Why, man, you're blind—
If you'd listen and learn with an open mind
Instead of speaking in parrot phrase
Of the 'grand old times' and 'the good old days,'
If you'd look about you and see—you'd find
Romance is living right now and here
Not dead and gone with the yesteryear!

"Man, O man! can't you look and see
What thousands of wonders have come to be?
These bolts and shafting that whirl and whir,
These chunky motors that hum and purr,
These lathes and punches which fill the floor,
These hammers pounding, these rolls that roar,
Why—they're Romance—and they make it, too,
By the magic spell of the work they do;
These tools of ours and the men who run them,
Don't dream of miracles—they've done them;
They've put Romance in the shape of steel,
They've turned the shafts, and they've forged the keel
Of many a ship that fights her way
Through surging combers and flying spray;
The train that thunders along the rails,
The ax that blazes the new made trails,
The cages that carry the miners down,
The dynamos lighting the clanging town,
The aeroplane in the sky's blue dome,
The plowshare turning the good brown loam,
The myriad wonders of the time
Have sprung to life from the workshop's grime;
And yet you sigh, and shake your head
And murmur sadly, 'Romance is dead!'"

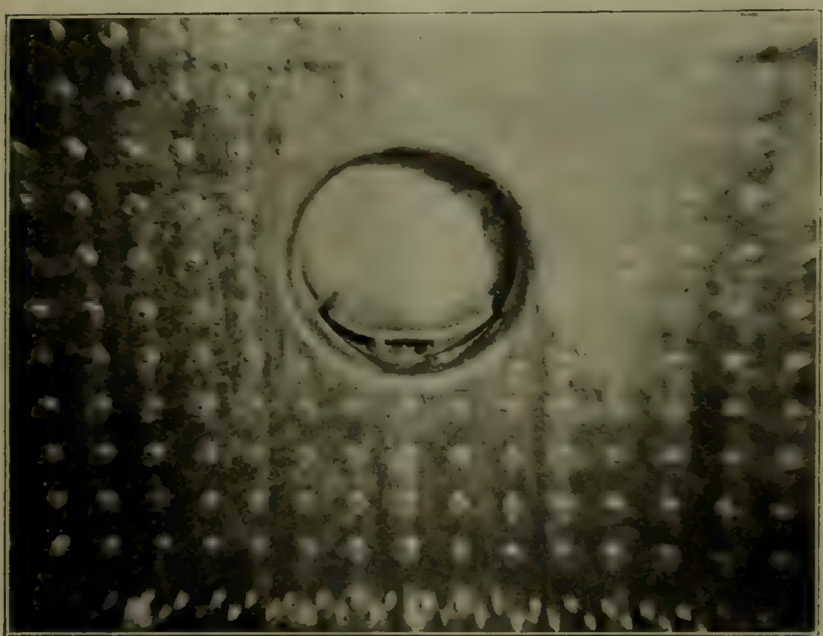
—*American Machinist.*

Oxy-Acetylene Welding

By F. A. Beyer, Gen'l Fmn., St. L. & S. F. R. R., Springfield, Mo.

The Frisco has during the past eighteen months installed and put in operation nine oxy-acetylene welding plants of the most modern and efficient design.

These installations are located as follows: One at the new shop at Springfield, Mo., where all heavy locomotive and passenger car repairs are handled; one at the North shop, which is devoted to the finishing of material and to heavy freight car repairs; one at the scrap reclamation plant, and the remaining six at various small shops or heavy enginehouse points over the system.



Three-quarter Door Sheet Welded In by Oxy-Acetylene.

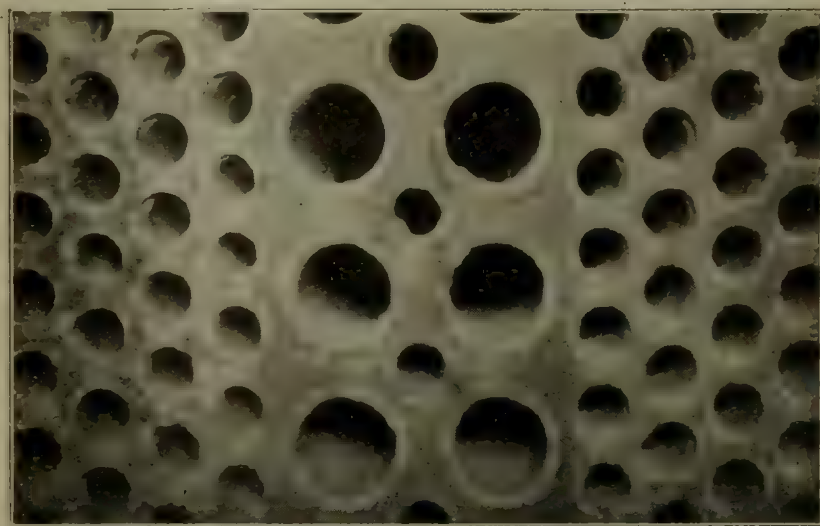
All plants are of similar design, being furnished and installed by the Oxweld Railroad Service Co. They consist of a low-pressure duplex acetylene generator and a duplex oxygen manifold to be used in connection with the cylinders of compressed gas furnished by the Linde Air Products Co.

At all the shops the oxygen and acetylene gases are piped from the central station to all parts of the shop; stations for connecting hose and burners being located at convenient intervals, so that work may be done on the repair pits.

The installation at the New shop is by far the largest of the nine; at present it consists of a 600 cubic foot acetylene generator and a 20-cylinder manifold. The capacity of the present generating station is insufficient, and a new plant is under construction, which will contain a 1,000-foot acetylene generator and a 35-cylinder manifold.

The unqualified success which has attended the use of oxy-acetylene welding and cutting process in the Frisco shops has made these plants an indispensable part of the shops' equipment. The quantity of work performed by this process has steadily and rapidly increased since the first month of operation. The wide range of operations to which this process is profitably applied is illustrated by the accompanying statement, showing the savings by individual items under various general groups.

Careful account has been kept of each operation performed by this method, and comparison made with the cost of completing the

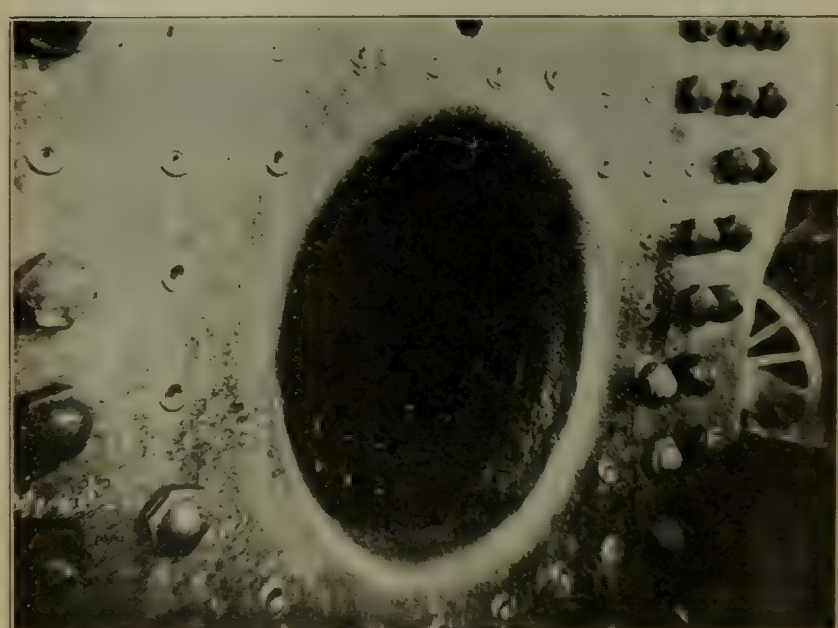


Flues and Superheater Tubes Welded In Black Flue Sheet.

same repairs by methods previously employed. The total net saving to the railroad after all expense for labor, material and supervision have been deducted was as follows for the period from April, 1913, to and including July, 1914:

April	$ 215.23
May	1,121.27
June	1,367.47
July	2,033.98
August	3,335.10
September	5,652.44
October	9,660.86
November	5,247.84
December	5,682.56
January	6,772.68
February	6,783.20
March	11,875.07
April	9,390.11
May	8,014.60
June	8,661.70
July	11,691.10

Broken Splice Leg Welded by Oxy-Acetylene.



Seam of Door Sheet and Back Head Welded by Oxy-Acetylene.

The uniformly satisfactory results which have been obtained from oxy-acetylene welding on the Frisco may be attributed mainly to the careful selection and training of burner operators. From each of the shop crafts the best mechanics available have been selected and carefully trained in the art of autogenous welding. These men, with their thorough mechanical training, understand thoroughly what constitutes a good repair job, and when once familiar with the operation of the cutting and welding burners, produce a superior grade of work.

The welding work is assigned as nearly as possible to mechanics of the trade to which the particular class of operation usually belongs; that is, firebox and boiler repairs are given to boilermaker welders; frames and other heavy castings and forgings are repaired by blacksmith welders; the lighter machinery parts, such as valve motion, crossheads, etc., are repaired by machinists.

Another great factor in the rapid progress of the Springfield shop has been the fact that the oxygen and acetylene are supplied from a central generating station, through pipe lines which reach practically every point in the shops. No such results as have been obtained would be possible where portable plants are employed.

The range of work to which this process has been successfully applied has been limited only by the capacity of the generating station. Parts varying in size from small high-speed drills to the largest of locomotive frames have been successfully welded.

By the use of proper methods, the correct filling material and flux, satisfactory results have been obtained in the welding of all of the metals which are used in locomotive or car construction. Cast iron, which usually proves the most refractory metal, is at present being welded with uniformly satisfactory results. Some difficulty was at first experienced, on account of excessive hardness of the welds made in cast-iron parts. Experience, however, has taught our welders that it is possible to make welds in cast iron which are as easily machined as the original metal.

As will be noticed from the foregoing staement, firebox repairs contributed largely to the total saving effected. It is the present practice to weld in patches, part or whole sheets in fireboxes, and also to repair cracks which are not serious enough to require patches.

Patches of small size are dished to take care of the contraction of the weld; the larger patches and part sheets are crimped around all the edges for the same purpose.

Connection Rivet Cut Off with Oxy-Acetylene Cutting Burner.

A Weld in the Top Rail—Engine 1266.

In the case of either patches or sheets, the part is fitted and bolted up complete before welding is begun. No difficulty whatever has been experienced with patches so applied in the matter of subsequent fracture through the welds.

Fifteen full sets of flues have been welded into the back flue sheet with uniformly good results. Some of these engines have been in constant service now for more than a year.

In addition to the engines in which full sets of flues have been welded, the superheater tubes are welded in all engines of this type going through the shop.

More than one hundred engines are at present in service upon which the main frames have been welded by the oxyacetylene process. One of the most remarkable of these welds is illustrated in accompanying illustration.

The frame in question was that of a Pacific type passenger locomotive, broken just behind the cylinder casting. A cross-section of the frame at this point measured 5½x13 inches.

The method employed in making frame welds is as follows: The frame is cut out in a "V" shape from both sides to the center at an angle of 45 degrees. The cutting is done with the oxy-acetylene cutting torch. The surfaces are then carefully shipped to remove all oxidized metal. The frame is jacked or wedged apart, usually about $\frac{3}{8}$ of an inch, and jacks are set to hold it in this position until the weld is completed. The frame is then preheated by the use of an ordinary oil burner, the flame being confined by a quickly erected furnace of loose brick. When the part to be welded has been raised to a cherry heat the furnace is removed and the welders begin immediately to apply the filling metal. Two men are employed, one on each side of the frame, and the weld is completed as rapidly as possible. After the completion of the weld the strain on the jacks is gradually released as the metal cools, allowing the frame to contract to its former position.

Not a single failure of a frame weld completed by this process has been recorded.

The repair of shop machinery parts, while in the matter of total saving effected does not compare with numerous other classes of work, is an important office performed by the oxyacetylene process. Broken-down machines often cause serious delay to the shop's output, it being frequently necessary to wait until new parts can be shipped from the factory. On numerous occasions

Frame of Engine 1057, Broken Behind Cylinders, Cut and Ready for Welding.

during the past year the ability to weld broken machine parts has avoided serious curtailment of the output due to the breaking down of important machines. The saving in time and money which is accomplished by work of this kind is an indeterminable quantity, and no effort has been made in figuring the saving effected, to place a value on such service.

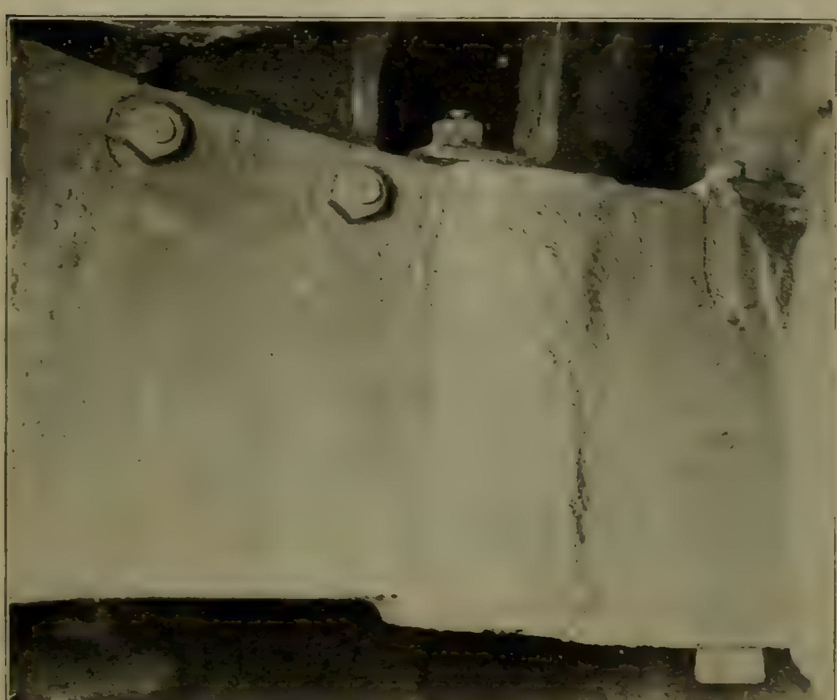
The cutting burners are put to a variety of uses about the shop and effect large savings of time and expense.

In removing old fireboxes the staybolts are cut out with the oxyacetylene flame in a fraction of the time and at less than one-third the cost entailed by the usual method of drilling.

When a front flue sheet is to be renewed the flues are cut loose in the back end, the front sheet is cut off outside the outer rows of flues and the full set of flues and sheet are removed with the crane. The saving in time and expense which this process permits will be amply apparent to shopmen.

In removing the back end from the barrel of the boiler the rivet heads are cut off with an oxyacetylene cutting torch. This method, as is shown by attached statement, saves more than one-half the time and decreases the cost by $5.51 per hundred rivets cut off and knocked out.

When new staybolts or radials are applied the protruding ends are cut off with the cutting torch. Not only is a material saving of time and money effected in this way, but a factor of more importance is that the bolts are not loosened in the sheets, nor are the ends damaged as is the case when the cutting off is done with hammer and chisel or nippers. From three to five bolt ends per minute are cut off by this method.



The Completed Weld on Engine 1057.

It would be useless to attempt to enumerate all the uses made of the cutting burners in the shop, but the foregoing examples serve to illustrate their great utility.

Concrete examples of the work which has been accomplished, as illustrated in the accompanying illustrations and comparative cost statements, will serve better to emphasize the value of the oxy-acetylene process in connection with the railroad repair shop than any general description of methods and results.

That an oxyacetylene installation is indispensable to the most economical operation of a modern locomotive or car shop has been demonstrated beyond question by the experience of the Frisco during the past year.

The elements of success in applying oxy-acetylene welding and cutting to shop practice are:

An up-to-date, efficient generating plant.

A piping system throughout the shop.

Employment of competent mechanics as welders.

Careful training of welders in the art.

Intelligent co-operation on the part of shop foremen.

Door Collar Welded in by Oxy-Acetylene.

Following are some figures on comparative costs:

COMPARATIVE COST OF APPLYING DOOR COLLAR.

Old Method.	
Cutting out door collar	$ 7.92
Drilling staybolts and plugs	9.24
Flanging, annealing and straightening collar	2.74
Truing and fitting up	6.60
Heating, laying up and drilling staybolt holes	6.60
Tapping and plugging	7.92
Applying and cutting off staybolts	1.32
Hammering up staybolts	.66
Applying patch bolts	7.26
Punching and countersinking	.75
Caulking seam	.82
Total labor	$51.83
Material	11.39
Total	$63.22

Oxy-Acetylene Method.	
Cutting out door collar	$ 2.38
Chipping for collar	.41
Flanging, annealing and straightening collar	2.74
Truing and fitting	6.60
Setting and welding	11.13
Applying staybolts	.66
Cutting off staybolts	.26
Total labor	$24.84
Material	7.96
Total	$32.80

Saving by oxy-acetylene method, $30.42.

COMPARATIVE COST PER ONE HUNDRED OF CUTTING RIVETS.

Old Method.		Oxy-Acetylene Method.	
Cutting off heads	$ 8.24	Cutting off heads	$ 2.73
Knocking out	4.12	Knocking out	4.12
Total	$12.36	Total	$ 6.85

Saving by oxyacetylene method, $5.51.

COST OF WELDING FRAME.

Engine 1266.

Old Method.		Oxy-Acetylene Method.	
Dewheeling, stripping, removing frame	$88.20	Removing and replacing front pair drivers, guides, crossheads, spring and brake rigging	$15.00
Welding frame	9.93	Preheating frame	1.80
Planing frame	1.64	Cutting out frame	1.75
Slotting frame	2.46	Welding	9.45
Handling frame to various shops	2.25	Cost of gas and welding metal	23.94
Replacing frame and accessories and wheeling engine	86.40	Total	$51.94
Replacing 108 frame bolts	135.00		
Replacing pipes	2.40		
Total	$328.28		

Saving by oxyacetylene process, $276.34.

Note—This was not a regular shop engine, but was in on account of broken frame only. All costs in connection with repairs are, therefore, given.

COST OF WELDING FRAME.

Engine 1057.

Old Method.		Oxy-Acetylene Method.	
Stripping engine, removing frame	$ 84.24	Stripping	$ 5.85
Transferring frame to forge shop	1.50	Cutting out for weld	.67
Welding and straightening frame	35.28	Chipping surface of "V"	2.05
Transferring frame to machine shop	1.50	Preheating frame	1.80
Machining frame	3.69	Welding with oxyacetylene	23.40
Transferring frame to engine	1.50	Preheating to relieve strain	.90
Replacing frame under engine	11.70	Cost of gas and welding metal	20.28
Reaming 91 bolt holes	31.59	Total	$54.95
Replacing 91 bolts, labor and material	113.75		
Replacing trailer frame, spring rigging, etc	41.12		
Total	$325.87		

Net saving by oxy-acetylene process, $270.92.

FLANGE OILING.

A paper on this subject was presented by F. W. Edwards, of the Ohio Injector Co. at the Western Railway Club on September 15. A brief outline of the development of the flange oiler was given and a number of cases were cited showing the savings made by the application of the hydrostatic flange oiler, both in flange wear and rail wear. The writer urged the purchase of the best oiler obtainable—one that was not an experiment—in order to obtain the best results. The paper brought out quite a discussion, mostly favorable to flange oilers, although one member claimed that they were of but little value and that flange wear could be largely eliminated by equalizing the lateral movements of the trucks so that the burden would be more equally distributed throughout the entire set of wheels. Another member stated that flange oilers must be given the proper attention in order to get results and that their value depended on local conditions, as regards track curvature, etc. A number of members cited cases where flange oilers had done very effective work.

BETTER MACHINERY AND FUEL ECONOMY.*

By Andrew Westfall, Engineer, Wheeling Division, B. & O. R. R.

Better machinery and how to get it should be the watchword of all employes connected with the operation of a locomotive, and particularly of every engineer and roundhouse foreman.

One thing which impresses me strongly is the semi-visible "swords points attitude" of shifting the responsibility existing between the engineers and the roundhouse foremen. It seems to keep them as far apart as if they were working for different companies.

We all know that it is the duty of the engineer to handle his engine in accordance with the principles of economy and safety. On his arrival at the terminal he should make an intelligent report of all work necessary to place the engine in good condition, and should make this report out in such a manner that the shop men will have no trouble or excuse for not locating the defects and making the repairs necessary to prevent failures. Not long ago I was called to run an engine on which the engineer who brought it into the terminal, had reported. After the usual preliminary report, at the top of the page he wrote: "Take the pound out of the engine, she is pounding herself to pieces." This report did did not convey any information, and opened a loophole for neglecting the necessary work. When I made an examination, I found that both intermediate driving box wedges needed adjusting, and that the left main wedge was down about three-fourths of an inch. The right main wedge bolt was also broken, and allowed the wedge to fall down on the pedestal brace. This made it very plain why she was pounding herself to pieces.

Now, the fact is, if the engineer who brought the engine in had made any effort at all to locate the reasons for the pounding, and had reported them, the proper repairs would have been up to the roundhouse foreman. All of this work could have been done in two or three hours' time, and there would not have been any excuse for the work not being done.

Since the pool system has been in force on the Wheeling Division, we have had some very poor engines, and an improvement could be made if the roundhouse people would only ask themselves the question "Does it pay to put off the work until some future date?" Our engineers should also ask themselves "Am I justified in not reporting the work when I am not sure it will be done?"

I followed up a case for ten days for the purpose of trying to show the people in the shops that it does not pay to put off the work or to leave some part of it until some more opportune time. I was called for a Q-1 class of engine, and was surprised at the similarity of the knocks on each side. I measured them and found the lost motion in the right main rod brasses to be 25/64 of an inch, and on the left side 23/64 of an inch, a total of ¾ of an inch that the pistons had to move before exerting their force on the main pin. Of course this movement is at the beginning of the stroke with full boiler pressure on the piston, which means a very bad strain on the pin and rods. In running 100 miles the drivers on this class of engine would turn about 31,520 times, and this knock would occur twice in each turn. This means that we would have this strain 63,040 times on each side of the engine in each 100 miles. With the engine working with full boiler pressure, there is a force against the piston-head of 90,478 pounds, and when this is considered in connection with the frequency with which the knock occurs, it can readily be seen why pounds and knocks should be kept out of the engine. Allowing an engine to run in this condition also affects the clearance in the cylinder, and means that more steam is required to fill the cylinder at a time at which it is of very little benefit, that is, when the crank pin is in the center. This additional steam also will have an effect on the amount of coal burned because the expansion of the steam taking place after the valve has cut off the supply from the boiler, will not be as great as if this condition did not exist. The exact amount of additional steam necessary could only be determined

*Extracts from an article in the *Baltimore & Ohio Employes Magazine.*

from an indicator card, but the loss would be about one per cent. and if an engine burns eight tons of coal per 100 miles, a condition of this kind would mean that 160 pounds of coal is unnecessarily used, or, one ton in every 1250 miles. If the brasses had been filed and the cross-heads lined up, it would have taken two machinists and helpers about three hours, and by reducing the strain on the rods and pins, the liability for a very expensive failure would have been eliminated. *Does it pay to put this work off until the next trip?*

It is up to the engineer to report work of this kind whether the trouble is in the front or back main rod brasses, side rod bushings, cross-heads, main wedges or crown-bearings. A little care on the part of the engineer will make it an easy matter to locate the work. By specifying on the work report book just where the trouble is located, it will not be necessary for the foreman to try to find out where the trouble is, and will also enable him to give the machinest who is to do the work, such information as will enable him to handle it with very little delay.

I have in mind a case of an E-24 class engine with piston packing broken. The foreman in charge where the work was reported, ran the engine out, and the blow was reported at each terminal for at least a week. When the engineer would protest to the foreman, he would say that they ran her from the other end that way and she would have to go back that way, as it was not up to him. After the engine had made about 500 miles in this condition and became so bad that it was difficult to handle a train, the packing was finally renewed. Only the fact that the piston was a tight fit in the cylinder, made it possible for the engine to perform any work whatsoever. This would make it appear that someone was responsible for an inexcusably bad and wasteful condition.

Cooperation means the congenial association of the laboring class of people for the furtherance of a definite, resultful and profitable end, and should exist among all employes of the railways, irrespective of position or class of service. Regular engine crews should be kept as near as possible to man the engines on each division, for when a crew is called from the extra list, they have to become acquainted with and accustomed to the idiosyncracies of their engine before they can develop its highest efficiency.

Never before have conditions on the American railways demanded as much loyal assistance from their employes as at the present time. And if every one of us would stand on our own responsibility and get out of the old rut of trying to shift the load to someone else (who perhaps has more than enough without trying to bear part of ours), we would have so marked an improvement that it would be bound to attract the attention of others and cause them to gird their armor and fight their own battles. What is a greater honor than to set a good example for our fellowmen?

SHOCKED THE SUPERINTENDENT.

He entered the superintendent's office in a kind of bashful, well-I-got-no-business-here sort of manner and quietly asked the busyman if the superintendent was in.

"I am he," replied that official without raising his eyes from the desk—"what do you want?"

"One of your trains killed my dog a few days ago and I thought I would stop in and—"

"Well, he had no business on our tracks; you should have kept him tied."

"Yes, I know," meekly responded the caller, "but I didn't, and he got on the track and was killed, and I thought you ought to—"

"But we won't! We don't pay for killing dogs on this road."

"Who said anything about pay?" replied the ex-dog owner. "I'd been trying for a month to get some one to drown that measly cur, and as the railroad has killed him for me, I thought you ought to be paid for the job. Here's two dollars."—*Railroad Employe.*

GREGORY SMOKE CONSUMER.

By Charles F. Gregory, M. M., Manufacturers' Ry., St. Louis, Mo.

The application of mechanical devices to locomotives, designed primarily to eliminate so far as possible the ejection of smoke from the stack, and secondarily to increase the combustion of the inflammable particles of carbon escaping from the stack, is a problem which, until the last two or three years, has not received very much consideration at the hands of our railroads.

The demand for the installation of such innovations has come, not from the railroads because of reasons of economy and efficiency, but from a source which has been productive of many burdens to our carriers, namely, public opinion, aided and fostered by the newspapers and other periodicals, all striving for cleaner and more healthful municipalities, towns and cities.

There is no question that the smoke nuisance is an evil, harmful alike to health and property, or that its presence to a greater or lesser extent, so far as we know now, is absolutely necessary. It has been recognized that its elimination even to a percentage of its grand total would be economical and beneficial to all concerned.

The pressure from the press, representing the public, for its abolition has been becoming more and more insistent, until our larger cities expend large sums of money annually in the employment of inspectors, whose duty it is to report the infractions of city ordinances directed at those who violate the statutes governing such matters. The existence of these laws has also caused the railroads to assume a great deal of expense in the employment of inspectors and instructors, who are occupied in detecting infractions of the ordinances and in teaching the firemen more scientific methods of maintaining their fires. This campaign of education has not proven entirely satisfactory in its results.

So far as the carriers are concerned this condition has been becoming more and more acute in the cities and the larger terminals. Many of the railroads operating within the city limits of our larger cities have been compelled, whether they deemed the expenditures of the amounts involved wise or prudent or justified, to install on their locomotives various devices which claimed to solve the problem.

Most of these devices have been expensive, not only when considered in the light of first cost, but in the light of maintenance and upkeep. Their attachment has, therefore, been the cause of a considerable outlay of capital.

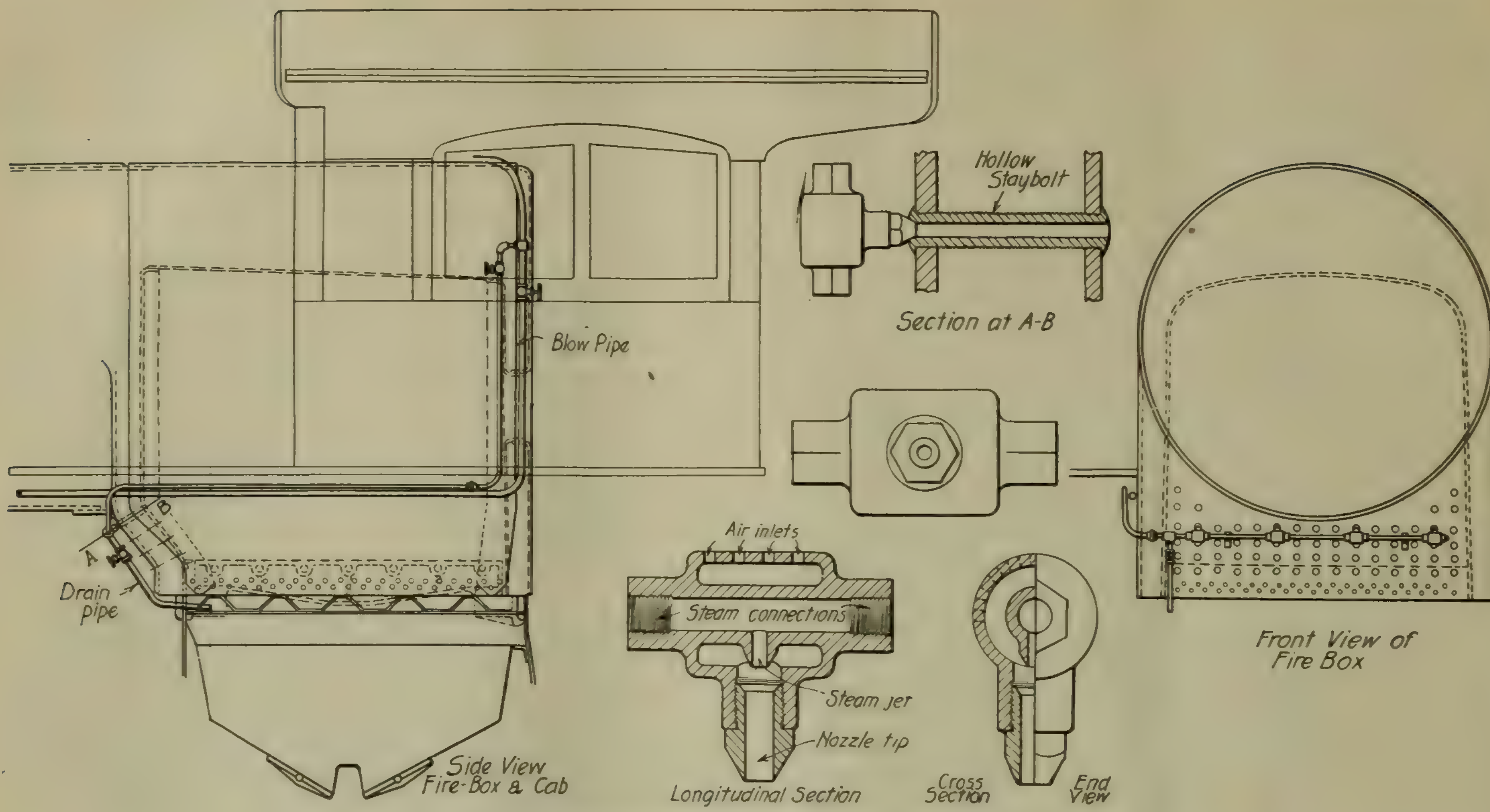
Our experience with the problem is confined to the conditions existing in St. Louis, where the city has enacted an ordinance imposing a fine for the emission of smoke for more than six minutes in the aggregate in any one hour, and then only while the fires are being cleaned.

Because of the existence of this ordinance it became necessary for the carriers entering St. Louis to experiment with such devices as were offered.

The company with which I am affiliated, the Manufacturers' Railway Company, installed at some expense one of the most promising inventions. It did not prove satisfactory and was removed. The dissatisfaction which it caused was due to several causes: First and of primary importance, it did not accomplish the results for which it was designed; it was complicated; was not durable; required constant attention for maintenance; was expensive to install, and created a constant overhead charge so long as it was in operation.

My thought as mechanical officer of the company was then directed to the solution of the problem so far as that might be possible, and after some experimentation I produced, perfected and applied to our locomotives a simple device which has so far exceeded original expectations that we feel justified in asserting that we possess one of, if not the most, efficient smoke consumers on the market.

Its operation has met with comments of great favor from city smoke inspectors, locomotive engineers, the district inspector of boilers for the Interstate Commerce Commission and various others competent to pass judgment.



Details and Application to Fire Box of Gregory Smoke Consumer.

These men have stated in positive language that it is one of the best things they have ever seen in operation.

The method adopted to achieve the desired result is similar to most of the inventions on the market; for, in fact, all efforts to eliminate smoke must be founded on the basic principles involving the combining of oxygen in such quantities and proportions as to form chemical action when brought into contact with the carbon present in the smoke.

Most of the applications of locomotive smoke consuming devices are made in the interior of the fire box, and it is this fact that causes most of the expense of up-keep, as nothing as yet has been constructed that will not crumble and fall away from the effects of the intense heat in the fire box.

The Gregory consumer, for such it has been named, attacks the problem from the exterior of the fire box, and it is so constructed that it may be applied from any of the four sides of a locomotive fire box, dependent upon the construction thereof. Practical tests, repeated a number of times, and substantiated by months of every-day, practical operation, demonstrate conclusively that it will eliminate from eighty-five to ninety per cent of the heaviest black smoke that it has been possible to produce by firing with soft coal. During most of the time the engines are in operation, with the consumer working, there is but the emission of thin streams of blue gas, which is quickly absorbed by the atmosphere.

Since attaching the device to its engines, the Manufacturers' Railway Company has received no further complaints from the Bureau of Smoke Abatement, city of Saint Louis.

In construction it is very simple, extremely durable, and once applied requires no attention, there being nothing to become deranged or disorganized. Its life may well be compared with that of the locomotive itself, the only replacement being necessary probably being the attachment of new black gas pipe and a small globe valve.

While no definite statistics are available because of the fact that the Manufacturers' Railway Company has no facilities for weighing its coal, reports of firemen, made as the result of the day's work, offer ample and substantial proof that its use is productive of a saving in fuel. This fact alone justifies its application to a locomotive.

It is operated by the fireman, and the only attention required of him is the turning of a globe valve wheel. We place particular emphasis on this fact, because one of the most difficult obstacles to overcome is the all too prevalent dislike of crews to operate new mechanical devices. They avoid such tasks wherever possible. If it is so desired the consumer can be turned on and left working during the course of the day's work, as its motive force, steam, is consumed in such small quantities that no lessening of the engine's efficiency results.

Another feature of great importance is the inappreciable amount of noise created by its operation, this feature assisting in securing the co-operation of the crews.

The combustible gases introduced into the fire box are at a temperature so high that absolutely no decrease in the efficiency of the engine results, and no lessening of the steaming qualities of the coal, which, in the Saint Louis field, is only a fair grade of standard Illinois bituminous, is produced.

All of the locomotives of the Manufacturers' Railway Company have been equipped with the consumer, and its evolution here has demonstrated beyond question its practical, every-day efficiency.

The officials of the Manufacturers' Railway have expressed their willingness to permit any one interested to see the invention in practical operation on its locomotives, and personally, as inventor of the device, and as mechanical officer of the company, I shall be glad to demonstrate the workings of the consumer to any one who will call upon me when in Saint Louis.

The Missouri Press Association in its annual convention recently held in St. Louis adopted a resolution setting forth that the railroads should be permitted to receive sufficient remuneration for the high-class service which they render, and the co-operation of legislative bodies and thinking citizens was invited to accomplish these ends. Membership in the association includes the editors and publishers of practically all of the daily and weekly newspapers in Missouri, embracing what is said to be the largest organization of its kind in the country, and the adoption of the resolution on the transportation question is regarded as representative of public opinion generally.

Plans are under consideration for increasing the capacity of the shops of the International & Great Northern at Taylor, Tex., it is reported.

Traveling Engineers' Convention

The twenty-second annual convention of the Traveling Engineers' Association was held at the Hotel Sherman, Chicago, on September 15 to 18, 1914. The first session was called to order on Tuesday at 10:15 a. m. by the president, E. P. Roesch, and prayer was offered by Rt. Rev. Samuel Fallows.

The convention was then favored with an address by J. F. De Voy, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul. Mr. De Voy stated at the beginning that he was going to read his paper in order to avoid being misquoted, but nevertheless he injected many extemporaneous remarks during the course of his talk. "Jim" De Voy wasn't built to read an address. He asserted that the association must go further before it fulfilled its obligations to the railroads, and then went on to give statistics as to the condition of railways here and abroad. The earnings of roads in the United States on a ton-mile basis are less than they are in Europe. The earnings of the St. Paul for the fiscal year 1912-1913 were but 79 cents per ton mile, whereas years ago they were three or four times that amount. It is the duty of the traveling engineer to do all he can to better the present unsatisfactory condition of American railways by using his influence on legislation.

The history and development of the traveling engineer shows that there is a lack of uniformity in opinion as to what is required of him. There are two common extremes on railways—where the traveling engineer has so many men under him that he never gets acquainted with them, and where he can ride with each man every two or three weeks. The best system is where the traveling engineer can ride with each man every one or two months. He should be allowed some latitude as to the men he rides with, and the fewer reports required the better the results. What a good trainmaster is to the operating department a good traveling engineer is to the motive power department.

Mr. Roesch in the president's address said that the railways have used every known device for economy, but that efficiency depends on the man who operates these devices. It takes time to train men, and in employing new men more attention must be paid to mental characteristics than has been done in the past. The theory of combustion should be taught to men before placing them on as firemen. Engine men should inspect and report all defects that come under the safety appliance laws. This will aid the inspectors at the terminals. In conclusion Mr. Roesch urged the younger members to talk and called attention to the value of the exhibits which had been prepared.

The secretary's report showed that the association had a membership of 1,027, a net gain of 70 over the previous year. During the year the association erected a monument to the memory of C. B. Conger, one of the charter members, at a cost of $1,075.

The executive committee recommended that the constitution be changed with regard to honorary members so as to read in effect that a member who has taken an active part may be made an honorary member by a two-thirds vote of the executive committee —the total number being limited to fifteen. The recommendation of the executive committee was adopted by the association.

Extracts and discussions of the papers and reports follow:

THE PREVENTION OF BLACK SMOKE.

Bituminous coal, being the fuel in general use on locomotives and on account of being high in volatile matter is the cause of nearly all smoke agitation, will be the only fuel considered in this paper. In order to eliminate dense black smoke, three conditions must exist, viz., to supply the fire with sufficient air, to thoroughly mix the combustible gases and air, and to maintain the temperature in the fire-box to cause the combustible gases and oxygen of the air to unite. In stationary practice this is much easier to accomplish than in a locomotive, because it is possible to obtain a much longer travel for the gases by proper furnace construction before the gases come in contact with the boiler sheet which has a cooling effect on them. The design of a locomotive boiler is restricted, whereas the design of a stationary boilei is seldom restricted in either length, width or height. The stationary plant can apply any kind of a stoker. On the other hand, there is not one of these stokers that can be applied to a locomotive. In stationary practice natural draft is generally used on account of the much lower rate of combustion, while on a locomotive, on account of the higher rate of combustion, it is necessary to use forced draft at all times. Even when the throttle is closed it is necessary to use the blower on account of draft restrictions in the smoke-box and lack of height to the stack. Experiments to obtain perfect combustion have been tried more extensively in stationary than in locomotive practice, not because locomotive men do not appreciate the value of these experiments, but because of the ease with which they may be conducted on stationary plants as compared with locomotives. It is found that inadequate draft is usually responsible for smoky chimneys; therefore it is evident that it is necessary to have a properly designed front end, including the exhaust nozzle, ample grate opening and ash-pan opening large enough to insure free access of air. Grate opening is more generally found to be restricted by failure to clean clinkers from between the bars than by faulty design. Trouble is sometimes caused in properly designed front ends by air leaks in the smoke-box. The effort to overcome fires along the right-of-way has resulted, to some extent, in restricting the air opening in the ash-pan. The ash-pan openings are frequently permitted to fill up with ashes, especially in winter on account of freezing.

On account of their intimate relation we might consider together the second and third requirements, namely, to thoroughly mix the combustible gases and the air, and to maintain the temperature in the fire-box to cause the combustible gases and the oxygen of the air to unite. We might say without going into the chemistry of combustion that this is a difficult problem, first on account of locomotives generally being hand fired there is an excess amount of air required to obtain the necessary oxygen to mix with the volatile that is given off from the coal immediately after it is placed on the fire. Therefore the smaller the amounts of coal fired at a time the better the result obtained. If heavy charges of coal are applied, there will not be sufficient air to mix with the volatile and the temperature of the fire will be materially reduced.

The brick arch is a great aid in smoke elimination, as it increases the travel of the gases and gives them a chance to combine with the oxygen of the air before coming in contact with the comparatively cool fire-box sheets; therefore, the absence of the arch makes it more difficult to eliminate smoke. When fresh coal is applied, the steam jets, beside giving a small mixing effect, are helpful in furnishing the necessary air over the fire. They require the constant attention of the fireman, because if they are not closed after the volatile is burned off they will inject a surplus of cold air which will have a tendency to reduce the temperature in the fire-box.

Special effort should be made to furnish a uniform grade of coal because it is hard for the best fireman to obtain the best results with a grade of coal which is continually changing. Better results will be obtained if an inferior grade of coal is furnished at all times, because where it is changed frequently the locomotive is drafted to burn the inferior grade and the better grade is wasted. In regard to the relative cost of fuel in connection with smoke elimination, it has been proved beyond questionable doubt in stationary practice that where plants have been remodeled to overcome smoke a saving in fuel and increased efficiency has resulted. In locomotive practice the same results have been obtained where the smoke-preventing devices have been judiciously used, but to obtain these results constant watchfulness is necessary.

Relative to the cost of repairs, locomotives must be maintained in good shape at all times to enable the crews to eliminate smoke. Of course this costs money, but it pays in the long run on account of the efficiency obtained when this is done. Minor defects must be looked after and there is no question but that it is a paying investment because it prevents engine failures and increases the engine mileage between shoppings.

The question is frequently asked: "Why do railroads in this country fail to control the smoke problem as well as they do in European countries?" Your chairman, when asked this question by the city commissioner of smoke, was unable to answer it, but suggested that conditions there might be very different from ours. The commissioner wrote several parties for information on the subject and among the replies was one from F. R. Wadleigh, of the firm of Wadleigh & Osborn, consulting engineers, Philadelphia, which we think worth quoting, as it shows that conditions are entirely different in Europe and much more favorable for smoke elimination. The following is taken from his letter:

"In the first place, it must be remembered that the European railways pay much more attention to firing than we do; their men are more carefully instructed, the observance of proper methods is strictly enforced, and every appliance is made use of that will decrease fuel consumption.

"Then, they are much more particular as to sizes of coal used. For instance, on the French railways each class of service has its locomotive fuel carefully divided as to lump and slack of briquettes and slack, by weight; passenger service uses 20 per cent slack and 80 per cent lump or briquettes; fast freight, 40 per cent slack; yard engines, 80 per cent slack, etc.

"It is true, as you say, that the European trains are much lighter than ours, but the locomotives are also much lighter, while in France, at least, the schedule speed of trains is higher than our average.

"The through trains of France and Germany run further without stops than do our trains, which is a factor in fuel economy and smoke prevention.

"The longest non-stop run in Germany is 196 miles at 44 miles per hour, while in France the longest is 203 miles at 47.6 miles per hour.

"As to the coals used: All of the railroads in the countries you name use large quantities of briquettes, the exact amounts of which I do not know.

"The following contracts were placed in 1912 by the Paris, Lyons & Mediterranean Railways, the largest in France: The total amount used is 1,830,000 tons, of which 600,000 tons was imported from England, Germany and Belgium; 90,000 tons large Welsh Monmouthshire steam; this is all double screened coal running about 25 to 29 per cent volatile; 140,000 tons Welsh smalls; this is for making briquettes; volatile, 13 to 15 per cent; 60,000 tons German smalls for making briquettes; will run about 28 to 30 per cent volatile; these two coals mixed in briquettes giving about 20 per cent volatile; 60,000 tons German briquettes; 100,000 tons Burham coking unscreened; will run about 23 to 27 per cent volatile; this is used as slack without briquettes.

The specifications as to quality on the same railroad are as follows:

"1. Coal must not produce adherent clinkers.

"2. Ash—large Welsh, 6 per cent; smalls, Welsh, 9 to 13 per cent; briquettes, 8 to 10 per cent.

"3. Large steam coal must contain from 25 to 35 per cent volatile substance and the smalls and patent fuel (briquettes) about 20 per cent.

"In Germany, Holland and Belgium the proportion of briquettes used is greater than in France, probably 75 per cent of the total fuel. Some of these briquettes are of lights, made without any binder at all. The use of sulphite pitch as a binder is steadily growing, as it is absolutely smokeless and cheaper than coal tar pitch. Even using briquettes with pitch as binder, it must be remembered that it is much easier to prevent smoke on locomotives than with raw coal carrying the same or even less volatile.

"The coal used in Belgium on locomotives is usually that which runs from 17 to 29 per cent volatile, the lower volatile coals (10 to 17 per cent) being generally used for domestic purposes or for lime and brick burning. In Germany and Holland the loose coal used is generally a medium low volatile, about 17 to 25 per cent; but the great proportion of the locomotive fuel is in the briquette form."

Mr. Wadleigh's letter, as well as information received from other sources, indicates that the use of briquettes is a large factor in the elimination of smoke from European railroads, but the cost of a good grade of coal is so small in this country as compared to the cost of briquettes that their use here is prohibitive, consequently it is up to us to follow up and improve the best methods now used in the complete combustion of bituminous coal.

Committee: Martin Whelan, (chairman), A. M. Bickel, P. K. Sullivan, W. A. Heath, B. J. Feeny.

Discussion.

J. C. Petty (N. C. & St. L.): I would like to know of a rule for the amount of free air in the ash pan and through the grates.

A. G. Kinyon (S. A. L.): The opening in the ash pan should never be less than 90% of the flue opening. There is no such a thing as getting too much air opening; however, grates should be so designed that coal won't fall through. The air openings in the grate should be 46% of the total area. We had to nozzle an engine down which had only 19% air openings. Briquetting without a binder is a matter of pressure. We shouldn't ask the fireman to close the door if we don't make it easy for him. Door hinges are sometimes worn and the catches are in poor shape. The stoker can use inferior grades of coal, but I have still to be shown as to the actual saving it effects. I have had considerable experience on hand and stoker-fired Mallets.

W. C. Hayes (Erie): The stoker people told us we could use anything, but we found that this was not the case. Tests made recently on the Erie indicate that no engine should have less than 100% of the flue area through the grates and that 150% would be better. With our "centipede" or triplex locomotive we had hard work to induce the Baldwin people to give us a 100% opening, but finally got it. Later we made some changes and got 130% opening. We have a device to determine whether we are getting 100% opening into the ash pan.

L. R. Pyle (Soo Line): It is standard practice on our road to have atmospheric pressure in the ash pan. Smoke prevention is best accomplished by having the fire ready before the engine leaves the terminal. If the managements will insist on no smoke in cities it can be done.

A Member: In Chicago we have 23 switcher engines, 20 of which are equipped with steam jets. The trouble is that the crews are not using the device. With their use we can get a clear stack from dense black smoke in 7 seconds.

W. C. Hayes (Erie): We have several hundred engines with no smoke prevention device except the brick arch. We get maximum steam pressure all the time and the engines carry the load. The crews are made responsible for the emission of black smoke. I recently rode for 35 miles on a heavy tonnage train with the pressure up to the popping point and not a bit of black smoke.

J. E. Ingling (Erie): With a vacuum determining device we found 2½" of vacuum in an ash pan. This pan had all the opening at the front end and by opening up the pan until there was no vacuum we made a saving of a ton of coal per day. We have now cut ash pans all we can and have put in netting. On certain classes of engines we put bricks back over the grates to a distance of 36". The smoke was eliminated and the engines burned less coal.

J. G. Miller (B. R. & P.): We have a damper arrangement for cutting off the draft, and I will send a blue-print of it to be incorporated in the proceedings.

J. B. Hurley (Wabash): We advocate a light fire, a bright fire and a level fire. The best smoke suppressor I ever saw is a good crew. The whole matter is an educational proposition.

E. A. Averill (Standard Stoker Co.): We recently made tests which show conclusively that the stoker uses less coal. The proper basis of comparison is the ton-miles per hour; speed must always be considered.

C. M. Kidd (N. & W.): If the elimination of smoke will save coal and prosecution, it is up to us to educate the firemen.

L. R. Pyle (Soo Line): It is our business to find out what will better conditions. It can be done.

Mr. McManamy: To eliminate smoke we must have the com-

bination of a properly designed locomotive and a properly educated crew.

F. W. Holtz (Mo. Pac.): We applied brick arches to a number of switchers in Kansas City and found that they caused the crown sheet to leak.

A. G. Kinyon (S. A. L.): We had a case where a crown sheet failure was blamed to the brick arch and upon investigating found that it was due to material collecting at a certain point on the sheet.

WEDNESDAY.

ADVANTAGES OF MECHANICAL STOKERS.

The advantage to be derived from stoker firing of locomotives is the ability to fire the engine continually up to its capacity, and it is found that the stoker-fired locomotive can either take the same tonnage as the non-stoker over the road in less time, or a larger train can be handled in the same time. As a concrete example of this fact we note that in a recent test for the capacity of locomotives a stoker-fired engine was operated for six hours, firing an average of 7,800 pounds of coal per hour, which means a continual capacity of the locomotive firing in excess of that which could be maintained by hand firing.

It has also been demonstrated that mechanical stokers have permitted the enlarging of the exhaust nozzle area from 5 to 5¼ inches, which means an increase of about three square inches, thus giving the locomotive greater efficiency. The principal reason that permitted the increasing of the nozzle is the keeping of the fire-doors closed, thus preventing the inrush of cold air which takes place when doors are opened for hand firing. Other advantages are obtained by not opening the fire-doors, viz.: doing away with the glare or dazzling light which is produced after dark and which makes the observation of signals more difficult. It also prevents sudden change in fire-box temperature which produces contraction of sheets or tubes.

A properly adjusted mechanical stoker will reduce the use of fire-hook or rake on fire-bed, as the distribution of coal can be regulated to prevent banking. This is an advantage, as the frequent use of rake disturbs particles of fuel which are carried by the draught onto the brick arch or lodged in flues, reducing the draught, heating surface, and is a loss of fuel.

The application of the stoker has proved to be a benefit from the standpoint of smoke abatement and there are some stoker locomotives at present being used in the heavy transfer service within the limits of large cities, resulting in practically complete elimination of smoke. Although all types of stokers are not showing an improvement in smoke prevention, the good results of some types indicate that future developments may be expected to produce good results along this line.

We have not received advice from the membership indicating that there is evidence of a change in the type of candidates for the position of locomotive firemen due to the adoption of mechanical stokers. But we feel that the following comparison of stoker and hand firing conditions will be of interest and worthy of consideration:

1. Hand firing conditions. The duties of men engaged in firing by hand require that they be educated in the expert handling of the fire tools such as the scoop shovel, fire-rake and furnace door. This knowledge is not of a nature that assists the man to understand the requirements and care of machinery that is necessary in order to become a successful engineer; therefore, men have first to develop their faculties to fill the requirements of hand firing and if successful, then they may devote their attention to the mechanical and operating duties in order to qualify for the position of engineer.

2. Stoker firing duties. Those engaged in stoker firing do not have to devote as much time and attention to the use of the methods employed in hand firing, but are required to operate the mechanical stoking machine which furnishes them with a practical experience in the care of steam driven machinery. This mechanical education should greatly aid in the development from fireman to locomotive engineer.

This, we believe, is an improved condition and should greatly increase the possibilities of securing a higher type of candidates for the position of locomotive engineers.

We have not received any information which indicates that the development of the mechanical stoker has reached a point where the utilization of cheaper fuel has been accomplished.

In conclusion, we will not attempt to state the cost of installation and maintenance of the mechanical stoker, as the different types will vary in these items; and as the advantages here presented for your consideration would be difficult to calculate in dollars and cents, we will not try to submit a comparative statement of expense and saving. But from the developments up to date it is safe to say that the advantages may be expected to greatly multiply with the service of the machines and by the efforts of the various stoker manufacturers.

Committee: J. H. DeSalis (chairman), S. V. Sproul, O. E. Whitcomb, T. B. Bowen, O. B. Capps, T. B. Burgess, H. F. Hensen, A. L. Lopshire.

Discussion.

J. F. Meredith (C. C. & O.): We have had a Hanna stoker in service since August, 1913, and it has given very satisfactory service.

C. M. Kidd (N. & W.): We have, or have had, all varieties of stokers on our road and have 40 Mallets equipped with the improved Street type. We are getting fine results from all three types of stokers which we have in use. With a stoker you have to fire so light that a stoker failure means an engine failure.

E. P. Roesch (E. P. & S. W.): We have quite a few stokers and have increased our tonnage 18 to 20% by their use.

F. Kirby (B. & O.): We are using 225 to 250 stokers. On one division, the heaviest on the road, we use nothing but stokers, and their operation has been successful. The efficiency of the locomotives has been increased 15 to 20%. Last January for the first time we furloughed firemen instead of hiring them, and we are enabled to get a better grade of men as firemen. We use both prepared and run-o-mine coal.

E. A. Averill (Standard Stoker Co.): We recently conducted some very extensive tests of stokers on the Norfolk & Western and in one case found the efficiency of the stoker for one month to be 99.7%.

A. G. Kinyon (Seaboard Air Line): I believe that the underfeed stoker presents the correct principle.

F. H. Smith (Hocking Valley): We have had two years' experience with the Street stoker. It has cost practically nothing for up-keep, and we have hauled heavy trains.

A Member: We have 8 Mallets equipped with stokers and have increased the tonnage and decreased the coal. The question of clinkers is up to the man on the engine. The stoker helps to get a better class of firemen.

J. H. DeSalis (chm. committee): The discussion of this subject has brought out that the use of stokers has resulted in increased tonnage, a better grade of firemen, the utilization of a poorer grade of fuel and a more even steam pressure.

During the morning the convention listened to an address by H. C. Bayless, mechanical engineer of the Soo Line. Heads of mechanical departments, said Mr. Bayless, have so many calls on their time for legislative matters, "safety first" work, etc., that they haven't enough time for strictly mechanical questions. Therefore, a trained staff of experts is needed. The traveling engineer has the opportunity to contribute much, as he is in practical touch with matters. He must keep before him ways of increasing efficiency. There is much to find out with regard to superheaters, for instance. He can observe headlights in a way that will give better results than a series of tests will. He should also be able to make many good suggestions in safety first work. Mr. Bayless stated that he thought the stoker had passed the experimental stage.

On Wednesday afternoon Frank McManamy, chief boiler inspector, Interstate Commerce Commission, favored the association with a short talk in which he told of the work being done by his

department, and said that government boiler inspection has done much to make the work of the traveling engineer more effective. The division of locomotive boiler inspection is reporting all defects whether in violation of the law or not. With welded flues many failures have occurred near the weld, due to poor welding. Never put a wrench on a washout plug while there is pressure on the boiler. It is a striking fact that most accidents of this sort have occurred when the foreman was either directing or performing the work.

CARE OF BRAKE EQUIPMENT.

An elaborate and comprehensive report on the care of locomotive brake equipment on line of road and at terminals, together with methods of locating and reporting defects, was presented by the following committee:

Geo. H. Wood (Chairman), B. Hyanes, R. E. Anderson, W. V. Turner, Edw. Bales.

The report was very complete and covered 36 pages. An abstract of it would hardly do it justice, as it goes very much into detail. It brought out a lively discussion, which lasted the rest of Wednesday afternoon.

THURSDAY.

OPERATION OF ALL LOCOMOTIVES WITH A VIEW OF OBTAINING MAXIMUM EFFICIENCY AT LOWEST COST.

Realizing, as we do, the magnitude of the subject before us, the innumerable angles from which it might be reviewed, and the varying conditions surrounding locomotive operation, your committee have deemed it necessary to circumscribe certain fixed limits in order that some of the prime factors effecting operation may be dwelt upon and their relation to each other shown, therefore, we have sub-divided the original subject as follows:

First—Assignment and distribution of power.

Second—Classified or general repairs; when and how made.

Third—Location, application and operation of lubricators, injectors and other boiler attachments.

Fourth—Terminal inspection and maintenance of locomotives.

Fifth—Superheaters, brick arches; their care, operation and maintenance.

Sixth—Selecting, employing, promoting, examining and instructing engineers and firemen with a view of securing and maintaining good service.

Seventh—Terminal and road facilities for turning and prompt handling of power.

Eighth—Handling and firing of locomotives with a view of obtaining maximum efficiency.

Ninth—Heat, steam, power and time that is wasted, and how to avoid it.

Locomotives with weak flues, or flue sheets, when assigned to some divisions, may result in obtaining high class service for many months with nominal cost for running repairs, while this same power if assigned to an adjoining division might give unsatisfactory service with frequent engine failures and expensive operation owing to an unfitness for the work required. It is self-evident, therefore, that to obtain maximum efficiency at minimum cost the matter of assigning power should be made with due consideration from both operating and mechanical points of view, observing not only the physical condition of the road bed and bridges, the capacity and fitness of terminal facilities for the care, up-keep and turning of the power assigned, but also its adaptability to meet the requirements of service, in either freight or passenger, taking into consideration the weight and schedule of trains.

Tabulated figures on locomotives maintenance, by Suffern & Son of New York, show that maintenance of all locomotives exclusive of depreciation charges on all railroads in the United States in 1911 was equivalent to 8 per cent of the total operating expenses.

With such figures before us the problem is yet unsolved, as there are no figures available to show what per cent of the total operating expenses are represented in losses caused by reduced tonnage, doubling hills, extra fuel consumption, delays, over-time, etc., not infrequently brought about by striving to obtain greater mileage from power between shoppings.

The cost involved by early shopping of power may be an item of profit or expense depending largely upon the general condition of the engine and service required, also the demand for power. In some cases badly worn engines may successfully and efficiently fill a requirement provided the work is sufficiently light. Cold locomotives crowding the roundhouses or back shops, awaiting repairs, represent an enormous investment of unproductive capital, and if such power is capable of rendering profitable service, although not in first class condition, it may through a special effort, be left in service with much greater profit than to be completely idle.

The foregoing conditions indicate that the most profitable time for shopping of power depends very largely upon local conditions, density of traffic in some localities with many high class freight trains, and other important traffic with an increasing public demand for better service, would not warrant the working of power in other than first class condition, while branch lines, unimportant freight or switch service, may provide suitable places to obtain additional wear from locomotives between shoppings.

An item of expense not commonly recognized may be incurred in an effort to compete with other lines in obtaining a maximum mileage between shoppings, although conditions of service may be contrasting.

Much matter bearing on the subject might be reviewed, but the foregoing should suffice to draw attention to the matter and arouse thought as to the most economical time for shopping of power.

Power received from the general repair shops after overhauling should be known to be in perfect condition before being returned to the operating department for service. Mr. Adams, of the Cotton Belt, has said that power overhauled for the first time should be in better condition than when received from the builders, and in a measure justifies this statement by adding that power once in service usually develops certain weak points that should be changed and strengthened at first shopping; but if not well done, may cause engine to render inefficient service and increase the cost of operation and in some cases require shopping for further repairs.

The item of breaking in power after over-hauling is an item worthy of attention, as newly over-hauled engines put on fast runs may result in heating of bearings, cut journals, or injured machinery, therefore, it is better to know that power is properly broken in before placing in service.

Scale matter is another item of hidden expense. It is not unusual for locomotives to use 8,000 gallons of water while making fifty miles, or over 12,000,000 gallons while making 80,000 miles, therefore, unless such water is treated or exceedingly pure, it will be seen at a glance that the amount of scale deposited from such quantities of water evaporated must be great, although the boiler washing is regular and the best that can be obtained.

Experiments have been conducted by Government experts and others on scale matter in steam boilers, and its effect on fuel losses, the result of which show whether such scale is soft or hard it is a poor conductor of heat. However, this being a subject within itself, will not be reviewed at this time, other than to call attention to increased cost of operation where scale matter is allowed to accumulate on the flues or boiler shell in locomotive boilers, causing increased fuel consumption, increased use of steam by excessive use of the blower and in some cases leaky flues or fire box sheets, resulting in engine failures or delays. Locomotive operation and train handling under such conditions is expensive and unsatisfactory, therefore, should be avoided.

Location of all boiler attachments for safety, accessibility and convenience of operation and repairs, is a matter which may appear to some to be of small importance, yet may involve great expense if not properly placed. An injector or lubricator placed beyond the convenient reach of the engineer does not receive the attention and fine adjustment that economical service would demand, or that the same might receive if properly placed. Sander valves, hydrostatic flange oilers and other boiler attachments are equally important.

Cost of operation being greatly influenced by improper boiler feeding, improper lubrication causing increased friction which tests have demonstrated decreases the power of the locomotive from 12 to 15 per cent. Poor sanding of the rail where needed causing delays and overtime, are matters which render this branch of the subject one of importance, and one which should receive attention in all railroad shops.

The lifting injector should be located in the most convenient place for operation and maintenance and where possible should be located in the cab within convenient reach of the enginemen. The height of the location for the lifting injector is usually governed by the height of the top of the tank, as the best results are obtained by locating the lifting injector with the center line of the injector on a line with the top of the tank, whether placed inside or outside the cab.

The non-lifting injector is mounted below the bottom of the tank and is usually placed on a bracket mounted on the tail piece of the engine frame. There is a serious objection to this method of application, as it puts a constant strain on the injector steam pipe and steam pipe connection at the injector and at the fountain where the steam pipe is connected to the boiler steam supply. This strain may be relieved to some extent by making an expansion bend in the steam pipe between the source of steam supply and injector connections.

A safer application (where it is possible) is to mount the injector on a bracket suspended from the bottom of the mud ring. This would place the injector pipes under the same influence of expansion and relieve the strain from the steam pipe and connections.

The rule of a well balanced engineman is to operate the injector so as to maintain as near as possible a certain level of water in the boiler at all times. The boiler and water conditions usually determine that level.

The principal thing in maintaining an injector is, first, see that it is properly repaired and the tube sized maintained to a good standard. Also see that the tubes are kept free from lime.

All of the pipe joints must be kept tight The steam valve and steam pipe openings, the tank valve, goose neck, hose, hose strainer, feed water pipe, and branch pipes must all have the proper openings as per the specified size for the different sizes of injectors.

In connection with injector maintenance, the check valve in the branch pipes and at the boilers must be given the proper attention and the valves must have the proper lift. If these points are properly watched the injectors will give good results and be free from failure.

One of the most frequent mistakes made in the application of locomotive devices is made with the lubricator. The instructions sent out by the manufacturer are frequently cast aside and the lubricator is applied on the hit or miss plan, when it would have been much easier had the instructions been followed.

In operating the lubricator the enginemen come in contact with the instructions issued by the different makers of lubricators and to get the desired results he should follow these instructions.

In a general way the operation of the locomotive valve lubricator depends on the service requirement, particular attention should be given to the engine valve, engine valve conditions, and enough oil should be delivered to the valves at regular intervals to keep them free from cutting. To do this the lubricator feed must be regular under all conditions of throttle opening and steam must be regular under all conditions. As fast as a drop of oil leaves the feed tip at the lubricator a drop of oil should be delivered into the steam chest at the steam chest end of the oil delivery pipe.

As the flange oiler subject is a comparatively new one, it will be proper to be more explicit in the application of the same, especially those of the hydrostatic type, which have proven to be an efficient type for all classes of service. This hydrostatic type is more familiarly known as the Elliott system. The device consists of a sight-feed oiler, a system of piping or delivery flange nozzles. The sight-feed oiler is mounted on the left side of the back boiler head with the back of the oiler facing to right, and the front of the oiler facing to left. The height of the oiler should be about five feet from the seat box deck. The steam valve is tapped into the dry steam supply at the fountain on the boiler. Between the steam valve and oiler use a copper pipe, as it is very necessary that this pipe should be free from scale. From the oil delivery connection at the oiler the oil delivery pipe is extended with a gradual fall in the pipe from the oiler to flange nozzle at back of the front driver wheel. The flange nozzle is located on a center line with the driver wheel or about twelve inches above the center line. The clamp that holds the oil pipe and flange nozzle in position should be placed six inches above the flange nozzle. This permits adjusting the flange nozzle. The point of the flange nozzle is placed one and one-half inches to two inches from the flange and at an angle so that the center line of the flange nozzle will be on a line with the top of the flange throat and the side of the flange nozzle clears the wheel tread three-fourths of an inch.

The operation of this flange oiler is practically the same as any other lubricator. First, it must be filled with the proper oil, asphaltum flange oil. No other oils or greases will do the work as well. The steam is turned on full at boiler, the water condenser valve is opened and the feeds are set to feed the required number of drops per minute.

As this is a down drop sight-feed oiler, the oil dropping from the feed tip is carried from the feed chamber (immediately under sight feed pockets) into the oil delivery pipes under the influence of steam passing through the equalizing pipes. As the steam catches the oil it is carried through the oil delivery pipes to the flange nozzles through which the oil is blown under the influence of steam. As the oil and steam leaves the point of flange nozzle together, it is blown against the wheel flange, coating them with heavy, sticky oil that cannot spread to the tread or blow off of the flange. The fact that this heavy oil does stick to the flanges prevents flanges cutting and derailments and reduces curve friction. With other styles of flange oilers or flange lubricators, equal care should be exercised to have them applied and operated as recommended by those who furnish them.

Termial care for all locomotives is essential to good service, and beyond doubt has greater bearing on locomotive performance than any other one item.

Engines permitted to work when lame or with steam leaks in the smoke arch, valves or cylinder packing blowing, or badly stopped flues, may use extra fuel by the ton while enginemen are striving to save by the pound. Engines should be so drafted that they steam freely, their arches, steam pipes, superheater units, cylinder packing and valves should be known to be in perfect condition. Periodical inspection should be made of all draft appliances and a perfect measurement maintained of the sizes of the exhaust nozzles, location of draft sheets, etc., by so doing much time and expense can be saved where re-adjustments are necessary or for comparison of work with other power of the same class.

Whether inspection and reporting of work is done by the incoming engineer or delegated to an inspector where employed, may depend on local requirements, agreement or custom, but in all cases should be thorough.

The working hours of shopmen being short, and overtime expensive, running repair costs in some cases are necessarily increased by shopmen searching for blows, pounds, or other troubles because of improper work reports, and in some instances other work neglected on this account. The cost of maintenance and upkeep of power can be greatly reduced with an increasing benefit and training to enginemen by the enforcement of strict rules requiring close inspection and properly defined work reports from them. Some railroads require both engineers and inspectors to inspect and make separate work reports with a view of reducing the chances for delay or accident. Such double inspection should make the engineer more careful in reporting work, especially if his attention is called to over-sights on his part.

Engineers having the advantage of experience and training, together with the responding language of the engine at work, whether produced by natural sounds of perfect work, or the discordant sounds of blows, pounds, lameness or other troubles, should be in a

better position to locate and report necessary work than an inspector who catches an engine at rest.

Where engineers are relieved at points remote from the engine house or where busy terminals do not permit time for the engineer to properly inspect engine on arrival, small work books can be carried on the locomotive for the convenience of the engineer, making notes of needed repairs, delivering same with engine at each terminal. For this purpose the following form will be found very convenient and has been successfully used for some time.

Following the matter of repairs, care should be exercised in firing up locomotives and preparing them for service, they should be fired up sufficiently early to insure testing of the air pump, headlight, injectors and other boiler attachments, to know that all are in working order before delivering to the engine crew. Such precautions will avoid many delays and failures which amply justifies this work.

Proper record of the time that engines are at terminals should be maintained. This for the purpose of checking mechanical or transportation delays to power, terminal fuel consumption, etc.

The advantages derived from high degree super-heated steam, are many, and with proper handling and terminal care, will produce remarkable results in the way of increased efficiency and economy over saturated steam power of equal size and similar build. With such power and facilities at hand it is highly important that full benefit be derived from its use.

To insure high degree of superheat it is necessary to keep all flues clean and free from clinkers or soot. It is equally important to know that the superheater units are free from leaks and the cylinder packing and piston valve rings are in good condition.

Owing to the free steaming qualities and quick movement of locomotives of this class, it is possible for steam leaks to exist without any noticeable effect on the steaming qualities or power of the locomotive, and for this reason enginemen should be on the alert for slight blows, as high-degree superheated steam does not create the same sound as saturated steam, therefore, may be more severe than anticipated and deprive important parts of necessary lubrication.

Brick arches, when used, should be kept in perfect condition in order to insure maximum efficiency from their use. Locomotives drafted with the use of an arch will, as a rule, be more severe on fuel should the arch fail and locomotive be run without it. Terminal repair men should inspect and repair any defects found each trip. Partly fallen or burned arches are quite liable to tear holes in the fire and thus cause extra use of fuel and possibly result in stopping the flues.

In selecting, promoting and employing of new firemen, care should be exercised to secure men of good habits and possessing at least a common school education. They should be required to pass an examination and be given the necessary instructions to insure a knowledge and familiarity with the signals, rules and other important requirements connected with their duty.

Some roads require inexperienced firemen, after filling out the necessary application papers, to make several student trips in freight service with designated men, requiring them to repeat these trips until the engineer or engineers with whom he is required to ride agree that he is familiar with the duties and is capable of firing a locomotive, and that they would be willing personally to take him out.

Firemen promoted to the position of engineer or experienced men who are employed for the service, should be required to pass a mechanical examination under some examining official or board before being placed on the engineer's roster.

Many railroads are now using the first, second and third year progressive examination questions for the edification and advancement of their firemen. Such examinations, as a rule, stimulate general interest, not only among firemen but among engineers as well. Question books are distributed according to the advancement of classes. Then at educational or get-together meetings held under the direction of the traveling engineer or other officials, the subjects are thoroughly reviewed. Many engineers take an active part in these meetings and the interest and discussion aroused is of great benefit to both engineers and firemen.

The question of examination of firemen on the progressive examination questions, to meet with the best results, depend largely on local conditions and the man himself. As a rule, it should be so the men have some leisure for application and study. In all cases possible young firemen should be examined on the first year's questions shortly after six months' service as a fireman, and there should be some ruling from the master mechanic or officer in charge as to the disposition of those who fail or refuse to take the examination.

Coaching and training enginemen is an important factor in paving the way for skillful and efficient service, and should be encouraged by all officials. Men who make systematic study of their business soon qualify to pass favorable examinations and are certainly much more desirable employes than those with equal opportunities who make poor use of them. Employes should be encouraged to take an interest in this work, to organize clubs and hold meetings at stated intervals for the discussion of subjects relating to their work.

The matter of prompt handling and turning of power is an important factor on any railroad, as the earnings depend on the movement of locomotives and the service delivered.

Terminal facilities suitable for prompt handling and up-keep of power is, therefore, correspondingly important, especially is this true at busy terminals where trains are waiting and locomotives are in demand. Busy seasons in some cases render all terminals busy and at such a time severe loss may be sustained if conditions are such that power cannot receive necessary repairs and be turned promptly.

There should be co-operation between yardmasters, dispatchers and roundhouse foremen, in order to get best results in turning power quickly. Roundhouse foremen may be working on east-bound power, while west-bound traffic is waiting, and were this condition known to the foreman in charge he could have given west-bound power preference and avoided some delay. A message in such cases, or advance notice for power, would keep the mechanical department in touch with the operating situation and in many cases avoid delays.

Another item of importance is the prompt placing of supplies, delivering coal to coal chute, pulling cinder cars out of the way, etc. Such duties should not be regarded of secondary importance, but should be promptly handled, as much depends on this service to aid in the prompt movement of power.

Blocking roundhouse leads or delaying incoming power in the yards after its arrival is an item of expense, too frequently caused by unnecessary blocking of tracks. Power so delayed at a time when trains are awaiting movement, may cause great loss and should be controlled by those in charge. Congestion of traffic demands that the greatest care should be exercised by all parties concerned in favor of prompt handling and turning of power, and in order to do so co-operation between dispatchers, yardmasters and roundhouse foremen is necessary.

The most poorly designed locomotive is made better by special care and handling, while the best designed locomotive will not do well if improperly handled or fired.

Railroad operating costs are great, and the fuel bill is the largest single item of this expense, therefore, the largest field for loss or gain. It is not unusual for a locomotive to burn from \$20.00 to \$40.00 worth of coal per trip, or per day, or from \$600.00 to \$1,200.00 per month, and all locomotives on some divisions burn from 20,000 to 50,000 tons of coal per month.

Of this vast amount of fuel burned in locomotive operation, considerable of it does not come under the control of engineer or fireman. Locomotives having wide fire boxes consume a great deal of coal at terminals for fire-building or keeping them under steam going to and from their trains, etc. At least ten to twenty-five per cent of all fuel used by any one locomotive is consumed in this way.

Close co-operation should prevail between the heads of the transportation and the mechanical departments in the matter of ordering power and firing up before needed. Engine crews should be

prompt in responding to calls and reach their engine in ample time to know that the locomotive has all necessary supplies and in proper condition for the trip.

Engineers should have the lubricator properly set and feeding at least fifteen minutes before starting on a trip, and should exercise care in not slipping the locomotive while starting the train, more especially while the fire is light, leaving the terminal.

The use of lubricants, fuel, and all supplies on the locomotive being under the engineer's charge, he should exercise every possible care to avoid waste. To obtain economical and efficient service from the locomotive much depends on the method of handling lubricating, boiler feeding and firing, as well as the condition of the engine, make-up of train and co-operation of dispatchers, trainmen and enginemen. The engineer should strive to handle the locomotive in such a manner as to render the required service, working the engine at as short a cut-off as the service and grade will permit, remembering that steam represents fuel and money.

Modern superheater locomotives with cylinders 26-inches by 30-inches requires great volumes of steam to fill them when worked at a long point of cut-off, therefore, should not be so worked where the grades do not require it. Locomotives having cylinders 26-inches in diameter use steam when worked at 6-inch, 8-inch and 10-inch points of cut-off, respectively, for each revolution of the drivers approximately as follows: 6-inch cut-off, 12,620 cubic inches; 8-inch cut-off, 16,960 cubic inches; 10-inch cut-off, 21,200 cubic inches. The amount used per mile would depend on the size of the drivers, however, the foregoing illustrates the importance of the reverse gear and what it can do for the fireman or coal pile if not properly handled.

Handling the injector to properly supply feed-water to the boiler is also a matter requiring the engineer's attention, whether handled by himself or the fireman, should be known to be properly regulated. When the water supply is regulated in keeping with the amount used and kept at a proper level or uniform height, flues are not so liable to leak, the engine will steam better and use less fuel than when the feed water supply is irregular.

The engineer being in charge of the locomotive and supplies when on duty, should know that the fireman is exercising his best efforts and judgment, observing also that no coal is being lost from the tender, the gang-way or pops.

Locomotives may be kept in perfect condition at great cost, may be operated and fired in a manner 100 per cent perfect, loaded to full tonnage capacity, yet fail in good returns. The matter of hauling empty or half loaded cars of great weight and size, increases operating expenses and proportionately reduces net returns, therefore, should be a matter of mutual concern to every railroad in the land.

Committee: J. R. Scott (Chairman), P. J. Miller, J. J. McNeil, W. L. Robinson, C. W. Hyde, F. W. Edwards, M. H. Haig, W. G. Tawse.

Discussion.

W. H. Corbett (Mich. Cent.): On switchers we used to have a small sand pipe in front of the forward drivers and had trouble with the pipe stopping up. Then we placed the pipe between the drivers and had no further trouble.

A Member: I saw a device recently for getting rid of the sand on the rails after the engine had passed on. It consisted simply of a steam jet back of the rear driver and it was found that it increased the tonnage.

E. P. Roesch (E., P. & S.-W.): Down in Mexico I saw a water jet used ahead of the driver to wash off and give gripping power. This, of course, could not be used in many sections of the country.

J. C. Petty (N. C. & St. L.): We tried out lead sand pipe joints with good success, although we get some wet sand and have to tighten them up occasionally. If you will thread out the bottom of the sand pipe aways and screw a washer up in you will be surprised at the good results. With regard to flange oilers, they have just tripled the life of the flange on our road.

A Member: We are getting excellent results with the Chicago flange oiler on the Virginia Southwestern. Where we formerly had to renew tires every six to eight months, with the oiler we run 18 months.

J. E. Ingling (Erie): The oilers are all that is claimed for them—we have a large number on freight and passenger engines. We keep a record in the cab of each engine, showing when the superheater flues were cleaned. The man in the cab then knows their condition and as a result the flues are kept in better condition. An important item is the inspection of coal at mines, for this is the first place to start saving coal. It has also been found by test that it takes about 300 pounds of coal to get a heavy train in motion again after stopping at a signal. We should keep after the transportation people to avoid this condition. To get the best results superheaters should be run at 25 to 30% cut-off.

W. C. Hayes (Erie): Any modification of the working of the engine should be made with the reverse lever and not by the throttle. On tests of our triplex locomotive I insisted on a wide open throttle and when it was closed and opened again you could see the increase in power.

W. A. Buckbee (Locomotive Superheater Co.): On tests conducted during the last year it was proven that the full throttle proposition is the correct one. In the last year we found trouble from the fact that some think that they must have the boiler chuck full of water. This causes a rush of water into the superheater and cylinders. There are many engines with insufficient ash pan opening. Another thing that should be given attention is terminal fuel consumption—it is very large.

W. C. Hayes: The Erie has discontinued the use of air and relief valves with no evil results.

B. J. Feeney (Ill. Cent.): When we had pooled engines it was impossible to find who was responsible for neglect and we had many engine failures. Now without pooled engines, they run from overhauling to overhauling without failures.

J. W. Eubank (C. & O.): The "Perfection" valve oil is as good as superheat valve oil. The superheat oil was made to meet the demands of the railways, but I believe it carbonizes more than the "Perfection."

L. D. Gillette (Ry. Comm. of Canada): The doctrine of the pooled engine is that the shop will take care of the engine and the shop don't.

FRIDAY.

CHEMISTRY OF COMBUSTION.

A very interesting and complete lecture on this subject was given by A. G. Kinyon, superintendent of locomotive operation of the Seaboard Air Line. Mr. Kinyon started in with simple and brief definitions of elements and compounds, and built up his subject to show the influence of proper combustion in a locomotive fire box. The first part of his lecture was illustrated by a number of chemical experiments, showing the principles of combustion. He made it clear that the burning of coal in a locomotive fire box is a chemical process in which it is absolutely necessary that oxygen come in actual contact with the substance to be burned. The proper burning of coal is a question of supplying enough oxygen. The carbon of the coal burns at a temperature of 914°, but the volatile matter will not burn until a temperature of 1800°F. is reached. The result of perfect combustion is CO_2. The blue flame sometimes seen at the stack is the result of imperfect combustion—the CO given off is uniting with another atom of oxygen at the stack. Black smoke is the unburned carbon of the hydrocarbons. The steam jet prevents black smoke because it mixes the oxygen of the air more intimately and entrains air. However, it sometimes reduces the temperature of the fire box below that of the burning temperature of the volatile gases and thus causes incomplete combustion, although black smoke is eliminated. The second part of Mr. Kinyon's lecture was illustrated by lantern slides, showing proper and improper methods of handling a fire. The lecture held the attention of a large audience for over three hours, which is evidence of the interest shown in the lecture.

SPEED RECORDERS.

Few replies were received to the questions sent, which is due to the fact that speed recorders, being a new apparatus, have not

been given a great deal of attention and are not very extensively used, except by a few of the railroads.

I find that we have in use on the railroads of the United States the following recorders: Boyer, Flaman, Hausshalter, and Railway; and on some of the private cars we have what is known as the Hutchinson Electric and the Warner. From the information obtained, I find that the Boyer, Flaman and Hausshalter are the principal recorders used on locomotives and trains. The Boyer and the Flaman are more generally used on locomotives, and the Hausshalter is principally used on cars and trains; while it can also be used on locomotives, as near as I can learn, it is not used as extensively on locomotives as the two first named recorders.

The Hausshalter recorder is purely a mechanical device, the main shaft of which revolves only about forty-five revolutions per mile, and when placed on a locomotive it enables the engineer to note at a glance the speed at which he is running, and besides gives records on the record tape.

It is also fitted with an alarm bell which can be set to ring automatically at any desired speed per hour. This enables the engineer to make whatever speed is desired until he hears the alarm bell informing him that he has reached the limit allowed. By use of the alarm bell the engineer can keep his eyes on the track at night or in stormy weather until he hears the alarm bell.

The time-recording feature of the Hausshalter apparatus is a very valuable one, particularly from the engineer's standpoint, as it proves without a doubt the time of all detention and station stops and the distance from the starting point at which they took place, which shows up the train dispatchers and station men when they are at fault or slow movement of train crews.

The advantages derived from the Hausshalter apparatus are that it enables the operating head to see at a glance where the trains are being held up; and when these detentions can be avoided, it enables the train to be handled between stops at a much lower speed, that is, when station stops are longer than need be, or where a detention is caused by bad dispatching or performance by baggagemen or trainmen.

The Boyer Speed Recorder is an oil pump arrangement and the main shaft turns about 540 revolutions per mile, and gives practically about the same information as all other recorders.

The Flaman, as near as I can learn, is constructed on about the same principle as the Boyer and gives about the same information on records as the Boyer or Hausshalter.

We have information that one railroad in the United States has 295 speed recorders of the Boyer type on locomotives and fourteen on private cars; the same road has forty-two Hausshalter recorders on baggage cars, and one on a private car.

While the Hausshalter apparatus is the only machine on the market that has the alarm bell attached by its manufacturer, I have information that there are two different devices called the electric annunciator that can be attached to speed recorders of any type that are not provided with the alarm bell.

The device consists of an attachment fitted to the machine itself with an electric bell, one or more dry cell batteries, as may be necessary, and the required amount of insulated copper wire; a low voltage electric light may be used if so desired. The attachment fitted to the machine may be so placed that the bell can be rung when any desired speed is reached and can be rung as long as the speed is exceeding the adjusted limit. It may be set to ring for two miles above the limit and if the rate of speed is more than two miles above the limit the bell will ring until the decreasing speed reaches and passes below the limit at which the device is set. The device has been thoroughly tested on six different engines on one of the leading railroads of the country and the results have been very successful, as the device has met all the claims made by the inventors. One great advantage it possesses is that if the recording gauge is broken or for any reason it is out of service the bell begins to ring when the speed limit at which it is set is reached. This device has been patented and can be furnished to any one who desires it by applying to the patentee. Engineers who have run engines equipped with this device like it very well and consider it an additional safeguard.

It is claimed by the different members furnishing the data that one of the advantages derived from the use of the speed recorder is the factor of safety; it can also be used to advantage for a check on trains in the way of excessive speed, and from some of the recorders we can get the time of stops, and the number of stops on each trip. The recorders are so constructed that they register the speed and the stops on a tape placed within the recorder box. There is an attachment leading to a gauge in the cab of the locomotive, and where the recorders are used on trains, the gauge is usually placed where the engineer can see it very readily without taking his eyes off the track for any length of time. He can see the speed that he is running at night as well as in daytime, which enables him to handle his train at a more uniform speed. This is of great assistance to him in carrying out instructions where there are slow orders and also to keep within the limit of the speed restrictions, which vary on the different divisions of each railroad. I also find that it is claimed that the speed recorder is a great factor in settling disputes in regard to speed at time of accidents, and in some instances it is claimed that there was very little difficulty experienced in settling cases where the railroads have been prosecuted for accidents to people in passing over crossings and wagons or automobiles being struck by trains, where witnesses claimed that speed was exceedingly high, the records of the recorders were used to great advantage by same being produced at the hearing of the case.

We also find that where we have reports of excessive speed over a portion of track where we have a slow order and there is a question raised as to the accuracy of the report, it has been found that the records of the recorder when produced were used to great advantage in settling the argument. It has also been claimed that a great deal of benefit is derived from the use of speed recorders in the way of reducing heated bearings on engines and cars, from the fact that where a violation of the speed limit was a general thing on some roads before the recorders were used, it was found that after the recorders had been placed on the locomotives and the enginemen had been called in for violation of the speed limit and cautioned they afterwards lived up to the instructions, and thereby reduced the likelihood of heated bearings to a great extent.

It is also claimed that by maintaining a uniform speed as possible over an entire division of road it is much easier on the track, machinery and cars and considerably reduces the expense of maintenance.

In handling the heavy fast passenger trains of the present day it is very difficult for the engineer to accurately judge the speed, especially in dark and stormy weather, and it has been found that where a speed recorder is being used a more uniform speed is maintained by the engineers.

From data received it is claimed that by using the speed recorders the operating expense has been reduced in the way of accidents to trains running at too high a rate of speed, which often caused derailments, and from heated bearings, causing delay to trains which results in additional operating expense. With the use of the speed recorder there has been less trouble in settling claims or damage suits, which reduces the operating expenses. In some of the data received it is claimed that the fuel consumption has been increased, due to the speed restriction, from the fact that when trains were permitted to descend grades at a high rate of speed (from sixty to eighty miles per hour) and ascend the grades at a speed of from thirty to forty-five miles per hour the fuel consumption was less than at the present time, when they have to maintain a higher rate of speed on the ascending grade in order make the schedule time, and in order to do so they have to work the engine harder and thereby use more fuel, which will increase the operating expenses to a certain degree.

Relative to the cost of maintaining the speed recorders, I could not get anything very accurate. One road gave an estimate cost of from $120 to $140 per year for each machine in use for material and labor. Another road estimates the cost of material and labor at $75 per year for each machine used; they claim that they cannot give anything definite at the present time, but will

find the actual cost and expect to have some definite information on cost of maintaining the recorders in the near future.

FREDERICK KERBY.

Discussion.

G. Dillard (Frisco): We find that speed recorders have reduced our derailments. There should be some variation allowed however, at least five miles, so that engineers won't get called if it is a fraction over.

J. R. Scott (Frisco): We have a large number of Boyer recorders in use on both passenger and freight engines, and on large power engines, including Mallets. With Mallets, with trailer under the cab, we can place the recorder directly under the cab. This keeps the cable short and reduces the chance of error. With Pacific type engines, we have the recorder on the front trucks and the bronze cable is passed through considerable distance. In this case we find it difficult to keep the recorder and indicator corresponding with each other.

F. P. Roesch (E. P. & S.-W.): We use an instrument which looks like a large clock and is situated in the cab in front of the engineer. In the center of the device is a regular clock and surrounding it is a dial which has red and black hands. The red hand indicates the speed limit and the black hand moves with the changes in speed. It is one of the best aids the mechanical department has. We have a speed limit of 65 miles on passenger engines and 35 miles on freight engines.

The paper on "Scientific Train Loading" came in too late to be printed for distribution and was held over next year. The secretary stated that it was a most complete and comprehensive paper.

The report of the committee on progressive examination for firemen was made by the chairman, W. H. Corbett. It was too long to read, but Mr. Corbett stated that it had been brought right up to date. He stated that some roads are trying to make it standard on their roads and are buying it for the use of the firemen.

The committee on changes in the constitution and by-laws made no report.

The committee on subjects reported the following topics for the 1915 meeting:

What effect does the mechanical placing of fuel in fire boxes and the lubrication of the locomotive have on the cost of operation?

Recommended practices for the employment and training of new men for firemen.

The advantages of the use of superheaters, brick arches and other modern appliances on large engines, especially those of the Mallet type.

How can the road foreman of engines improve the handling of the air brakes on modern trains?

The electro-pneumatic brake.

The effect of properly designed valve gear on locomotive fuel economy and operation.

Scientific train loading; tonnage rating.

ELECTION OF OFFICERS.

It was moved, seconded and carried that the constitution and by-laws be changed so as to permit of the addition of two additional vice-presidents, making five in all.

The following officers were elected: President, J. C. Petty, N. C. & St. L.; first vice-president, A. R. Scott, St. L. & S. F.; second vice-president, B. J. Feeney, Ill Cent.; third vice-president, Harry F. Hensen, Nor. & Wn.; fourth vice-president, W. L. Robinson, B. & O.; fifth vice-president, George Kell, Grand Trunk; secretary, W. O. Thompson, N. Y. C. & H. R.; treasurer, David Meadows, Mich Cent. Mr. Thompson was elected secretary for life. The following were elected members of the executive committee: L. R. Pyle, Soo Line; F. P. Roesch, El. P. & S. W.; Al. Beardsley, A. T. & S. F., and E. Hartenstein, C. & A. Chicago was selected as the next meeting place. A gain in membership of 130 was made during the convention, making the total membership 1,157. There were about 550 members and guests registered during the meetings.

BEARING METALS.

By T. J. Johnston.

Each degree of frictional heat that is developed in a machine bearing is a measure of just so much useful power entirely thrown away in that each degree of heat shown in the bearing above that of the atmosphere represents just so much heat removed from beneath the boiler, which, instead of doing useful work, only produces so much additional waste in the machine. It is therefore very essential that machine bearings be as nearly perfect as it is possible to make them.

In order that a bearing may run cool, careful attention must be given to several important items; the proper materials must be selected for the journal and bearing, the wearing surfaces must be perfectly smooth, and of sufficient area and uniform bearing surface. These surfaces must, moreover, be furnished with properly placed oil grooves which will distribute a lubricant evenly to every portion. A constant supply of lubricant of sufficient quantity and proper quality must also be provided, and dust, dirt, and all other foreign matter must be rigidly excluded. As a matter of course, the mechanical design of the bearing must be right, but the selection of the proper bearing materials and the proper application of those materials are matters of first importance.

A good bearing material must fulfil the following requirements: It must be of sufficient strength to sustain its load; it must not heat rapidly; it must be easily worked; it must have good anti-frictional properties; it must have a long life with small loss of material due to wear; and (with the exception of cast iron on cast iron and hardened steel on hardened steel) it will usually be a material of an entirely different molecular construction from that of the revolving journal which it must support.

Chief among the materials which are used in the construction of bearings are: Cast iron, steel, gunmetal, phosphor bronze, and white alloys. Numerous other materials, many of which are patented, have also been used for bearings with more or less success. Some of these latter are tempered copper, coiled steel wire, aluminum, lignum-vitæ, and other hard woods, compressed paper, stone and glass compositions.

The white-metal alloys are solid materials composed of two or more items, such as aluminum, zinc, nickel, tin, lead, copper antimony, and bismuth, in varying quantities and fluxed and alloyed in various ways.

The journal when running may be completely borne by the oil film, but during the time of starting or stopping the film is broken, minute irregularities on the surfaces of the bearing and journal engage, and if the bearing does not yield, as in the case of a steel bearing and a steel journal, small particles are fused and torn out, and these accumulate at the entrance point, and may cut both the bearing and the journal.

With a steel journal running in a white-metal bearing, the bearing surface is entirely different in its molecular structure, the bearing inequalities are not strong enough to resist the minute inequalities in the journal, and so, instead of fusing, they yield and are smoothed out. Consequently, the bearing surface, instead of being injured by contact and momentary high coefficient of friction, is smoothed and burnished, thus preparing the way for a uniform wedge oil film with a minimum coefficient of running friction.

White-metal alloys have other advantages to recommend them for bearings besides their anti-frictional properties. They are very easily worked, and can be melted in an ordinary iron ladle, so that no special equipment is required for the replacement of worn bearings; they are very long wearing and show but little loss of material due to wear even after long service; they tend to reduce shock on machines as well as to deaden noise; and they can be very readily provided with grooves for lubrication, and are very easily fitted to a uniform bearing.

A fault to which all white-metal alloys are heir is their liability to melt and run from the bearing shell, should accidental overheating take place. It is to be remembered, however, that although other materials do not melt and flow when overheated, an equal

amount of heating will cause equally disastrous results to their properties as bearing materials.

All of the white-metal alloys which are used in the construction of bearings are somewhat erroneously called babbitt metal. In 1839 a patent was granted to Isaac Babbitt for a special type of bearing enclosing a soft-metal alloy. The features of this bearing were lips extending around the ends of the soft-metal to retain it in case of accidental heating and to prevent the soft-metal lining from being crushed or spread out under severe pressure. The alloy which Babbitt used in his bearing was probably composed of tin 24 lb., antimony 8 lb., and copper 4 lb., to each of which was subsequently added 2 lb. more tin. This gives a metal composed of 88.88% tin, 7.4% antimony, and 3.7% copper. Metals of this type, which approximate 90% of tin in their composition, are now called U. S. Government Standard or A1 babbitt, and all other white-metal alloys on the market for use in bearings, no matter what their composition, are called babbitt.

Genuine babbitt, when properly made, has a low melting point, is easily worked, and has good antifrictional qualities, and will stand a large amount of careless handling, but the constantly increasing cost of tin has made it necessary to secure a good babbitt with a cheaper metal as a base. Laboratory tests show that a lead-base babbitt will give very good results, but such tests of bearing materials are difficult and uncertain and apt to be misleading. Similarly, chemical tests cannot be wholly relied upon, since a very great deal is dependent on the actual making of the babbitt. But laboratory and chemical tests taken in conjunction with actual service tests furnish very reliable data, and a bearing metal developed along these lines may be counted upon to give consistent results in practical work.

Babbitts made up according to nearly 300 different formulæ are at present on the market. It would be of very great benefit to the users of babbitt if this number were greatly reduced and the process of manufacture so standardized as to insure a uniform quality of alloy. Except for a few cases, but two babbitts, one a lead-base alloy, the other a tin-base alloy, each being the best that can be made, are required for a complete line of bearings, ranging in weight from a few ounces to several tons. The best quality of high-garde metal should invariably be used.—*Electric Railway Journal.*

A RAILWAY LIBRARY.

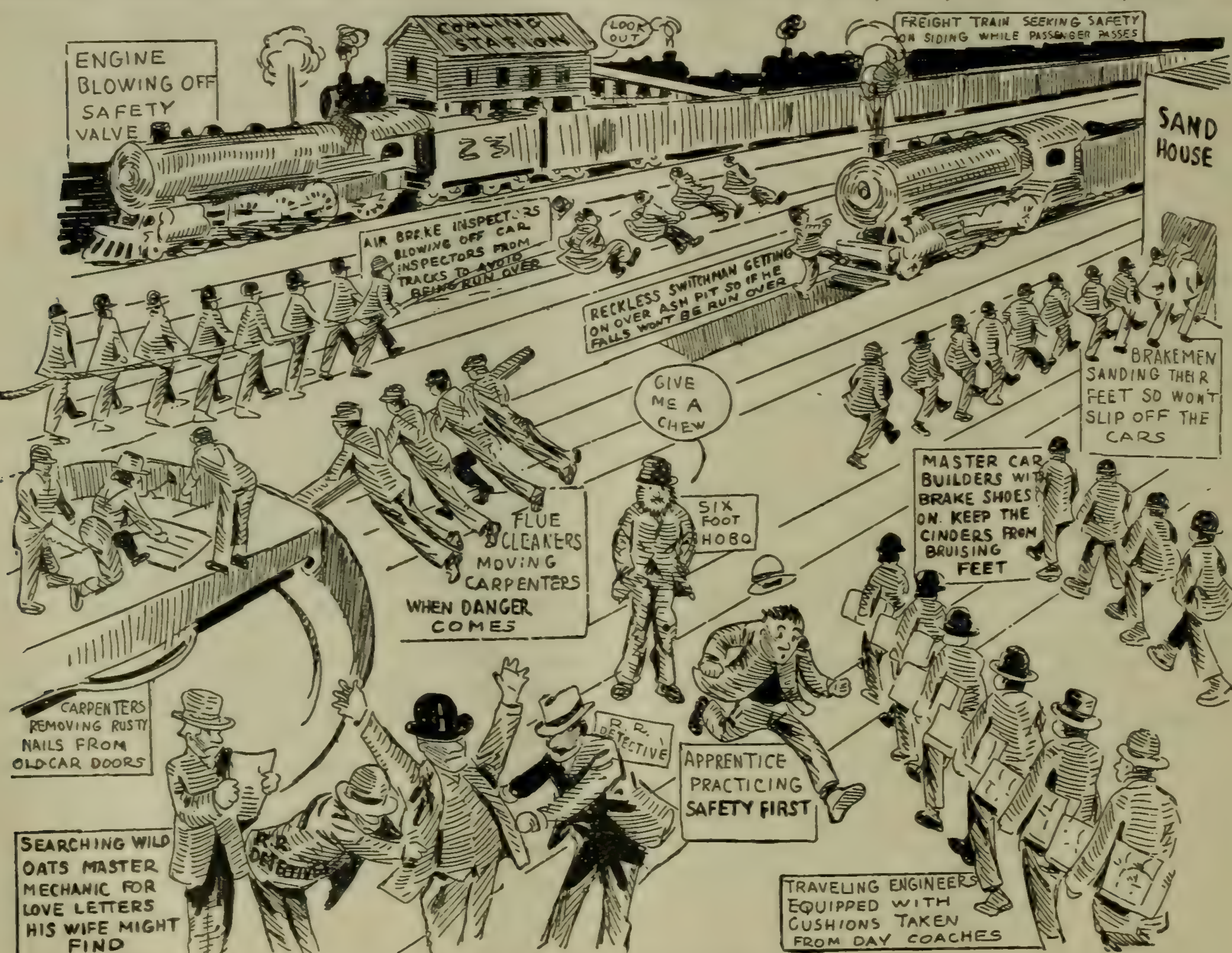
The Nashville, Chattanooga & St. Louis maintains at Nashville, Tenn., a library of over 7,500 volumes for the use of its employes. These volumes include fiction, history and technical subjects, as well as bound volumes of many magazines. Any employe may take out a book and keep it for two weeks, at the expiration of which the period may be renewed for an equal length of time. Employes stationed at points other than Nashville, of course, have the books sent to them. The library is very popular and a large number of employes take advantage of it.

THE SEVENTH ANNUAL convention of the International Railway Fuel Association will be held at the La Salle Hotel, Chicago on May 17 to 20, 1915.

The Louisville & Nashville has given a contract to Rommel Bros., Louisville, Ky., to build a roundhouse, shops, etc., at Lexington, Ky.

The directors of the Union Station Company at Chicago have asked for an extension of time of one year for the acceptance of the ordinances providing for the construction of the new Union station, on account of the impossibility of financing the project at this time.

The Nashville, Chattanooga & St. Louis will build a coaling station at Hollow Rock, Tenn., at a cost of $20,000.



The "Safety First" Movement As Seen by the Cartoonist.

PNEUMATIC TOOL EFFICIENCIES.*

By H. L. Brackenbury.

The pneumatic hammer is a combination of a cylinder, reciprocating piston, a valve controlling the flow of motive fluid to and from the cylinder and a throttle valve in the supply pipe. All the earlier engines were designed to produce rotary motion or to work pumps. The idea of using a free piston was first suggested as a good means of rock drilling. Among the earliest inventors in this field was George Low, an Englishman, who in 1865 patented a rock-drill having a hammering piston. Low is perhaps chiefly interesting as being the first to show a grasping-handle with manually-operated throttle valve within the control of the operator's fingers. Low was followed two years later by Doering, another Englishman, who was the first to patent a pressure-operated valve for this class of machine, in which the piston and valve are mutually inter-dependent, a principle used in all modern pneumatic hammers.

The first serious attempt to produce a practical metal-working pneumatic hammer seems to have been made by Boyer, of St. Louis, who, in 1883, patented a chipping machine with a grasping-handle and a throttle valve controlled by hand. Benjamin Brazelle, of St. Louis, in the early eighties obtained a patent in the United States for a steam pump disclosing a differential-area piston attached to a pump plunger, together with a differential-area valve, each of which served to control the operations of the other. Boyer seems to have drawn inspiration from Brazelle's invention, for in 1896 he brought out a metal-working pneumatic hammer involving Brazelle's design, but modified to suit the conditions of chipping, caulking and riveting.

It was soon found that there was a large field for pneumatic hammers for closing rivets, and this demand for pneumatic riveters led to the invention of the hammer in which a comparatively short piston was made to travel a distance much in excess of its own length. Boyer was probably the first to make a long-stroke hammer about 1899 by employing a valve at each end of the cylinder connected together by two rods of small diameter placed in longitudinal passages drilled in the walls of the cylinder. Meissner of St. Louis at about the same time brought out a long-stroke hammer with one valve only.

The problems presented to the manufacturer of pneumatic tools differ considerably from those involved in the production of other machines actuated by a fluid under pressure. The desirable qualities in a pneumatic tool in their order of importance apepar to be: Reliability, power, cheapness, lightness, ease of handling, compactness and low air consumption.

Up to the present probably too little importance has been attached to the last of these. It is not an uncommon thing to find a large and expensive air-compressor plant eating up power and delivering enormous volumes of air to supply the incessant drain of leaking pipes and hose, and the intermittent demands of most wasteful types of tools. Perhaps it would be no exaggeration to say that quite generally the amount of air lost by leaking hose is almost equal to that used by the pneumatic tools themselves. Suppose there are a number of leaks equivalent to a circular hole of about 1-10 in. in diameter. If the air supply be at 100 lb. per sq. in. pressure, the air leak will be about 15 cu. ft. of free air per min. or about 2 cu. ft. per min. of compressed air. The power required to compress this will be nearly 2 h.p. In other words, the leak would waste about 120 cu. ft. of compressed air per hr.

The factors governing the design of pneumatic drilling machines are entirely different from those for fixed machines. In the latter case, the machine is designed to run the drill at the speeds and feeds which will give the quickest penetration without undue wear to the drill. In the case of the pneumatic drill, the power is the governing factor, and therefore the design must be such as to use that power to rotate the drill at the speed at which the greatest penetration is given for the power. This is a slow speed, not a high one. The author found that an ordinary drilling machine requiring, for the same rate of penetration with fast speed and fine feed, double the power required with slow speed and coarse feed. These experiments were made with a drill in careful alignment with the work, and not with a pneumatic drilling machine supported by a springing arm and starting with the drill at anything but right angles to the surface of the work. The result is that the best effects are obtained by running the drill at slow speeds. The limits in this respect would be reached if the pressure required to feed the drill were more than could be conveniently given by the feed gear or the torque exceeded the strength of the drill body or cutting edge.

When the air is allowed to flow into the drilling machine, a high speed of rotation is set up until the feed is applied by the feed screw. The more rapidly the feed screw is rotated the quicker will be the penetration of the drill and the slower will the drill rotate, with the final limitation that if the feed is too rapid, the drill will stall suddenly and there will be no penetration. This appears to be a curious paradox, for, apart from considerations of wire drawing, the indicated horsepower of the pneumatic engine would seem to be dependent on its speed and the pressure of the air. The result arrived at is that the maximum speed of penetration is given by that speed of rotation at which the machine develops its minimum horsepower, but its maximum stable torque.

Considerable experience of running drills under test conditions has proved the importance of applying the feed with judgment. A man used to this work can get much better results out of a drill than can another man, equally intelligent and skillful, who is not so accustomed. It requires the greatest judgment to feed the drill so rapidly that it shall just escape stalling.

The idea of a minimum speed at which the pneumatic drill will run without stalling is of importance, because it should help to fix the gear ratio to be employed between the pneumatic motor and the twist drill. This critical speed is probably dependent not only on the size of the twist drill and the material it is to cut but also upon the laws connecting the torque of the pneumatic motor with its speed of revolution, while this relation in its turn depends upon the pressure of air supply and the length and bore of the flexible hose.

The history of other prime movers would indicate the probability that there will, and should, be an increase in the speed of revolution of the pneumatic motors. Everything is to be gained by obtaining increased power from the same piston by running it faster, provided the design still ensures reliability and good wearing qualities. If this change occur, it will involve an increase in the gear ratio between the drill and pneumatic motor.

Pneumatic drilling machines may be divided into two classes. The first class comprises those operated by an engine of the piston and crankshaft type, the second, those which rely upon some form of rotary engine. The second type is attractive on account of its beautiful simplicity, but, so far the author has not found one capable of giving as large a torque for a given air consumption as those of the first type. The principle difficulty in producing even a reasonably efficient rotary pneumatic engine is the large leakage, which seems almost inevitable.

In considering the efficiency to be expected from either type, we should remember that the problems to be faced by the manufacturer of an engine as minute as that required for a pneumatic drill are peculiar to the production of any small device operated by a fluid under pressure. Since the periphery of a body is proportional to its linear dimensions, while its area varies as their square, it follows that the leakage which occurs at a periphery assumes greater and greater relative importance as the size of that part decreases, and leakage is the principal bugbear of the designer of pneumatic tools.

The measurement of the brake horsepower of a pneumatic drilling machine offers no particular difficulty if great accuracy be not required. For commercial purposes a prony brake is quite satisfactory. If, however, it be desired to investgate comparatively small changes of brake horsepower, a number of difficulties have to be surmounted.

Two forms of brake have been tried. The first consisted of a hollow copper jacket resting on a sheave, which was driven by

* From a paper read before the Coventry Engineering Society, Coventry, England, January 23, 1914.

the drill. The back center of the drill abutted on a support carried on an old lathe shifting head. The whole arrangement was fitted to a discarded lathe bed. Arrangements were made to keep a stream of cold water flowing continuously through the copper jacket. The latter was lined with lead, so as to bear evenly on the sheave. To one end of this copper jacket there was attached a heavy weight resting on a spring-balance, while a lighter weight attached to the other end was immersed in a vessel of oil, which damped down the oscillations until they did not exceed about ¼ lb. on the spring-balance. Of course the lighter weight was corrected for the up-thrust of the oil. This arrangement was only fairly satisfactory. The brake used with it consists of a fine-quality cotton webbing, and the sheave has been made of larger diameter so as to minimize the rise of temperature.

It was found that over the speed range under investigation, 150 to 200 r.p.m., the horsepower developed increases more slowly than the revolutions. This speed range only was considered, because, it corresponded to the actual rate at which the drill would be run in practice.

The practical testing of pneumatic drills is difficult, but the testing of pneumatic hammers for power is even more so. The apparatus used in testing pneumatic hammers consists of a massive cast-iron bed provided with T-grooves, so that a heavy block may be bolted to it in any desired position. Against this block is placed the handle of the hammer to be tested. The snap of the hammer abuts against a heavy block, which can swing about a vertical pivot fixed to the bed. This swinging block is controlled by a spring, which can be adjusted by means of a screwed bolt passing through the fixed abutment. To the swinging block is fixed a light-steel arm carrying a stumpy pencil, the point of which rests on a strip of paper which can be reeled by hand off one drum on to another. As the instrument is only required to give the speed of the hammer, and a general idea of the type of oscillation produced, there is no need to employ a uniform drive for winding the paper.

Finally, although the production of a perfect pneumatic hammer appears to be more difficult than the production of a perfect pneumatic drilling machine, the author believes that the designs of hammers have reached a point nearer finality than the designs of drilling machines.

AIR-BRAKE STORY AWARDS.

The committee of three judges, consisting of W. E. Symons, mechanical engineer, Chicago, Illinois; Willard A. Smith, president and manager, *Railway Review*, Chicago, Illinois, and W. V. Wright, managing editor, *Railway Age Gazette*, New York, N. Y., in whose hands the Westinghouse Air Brake Company placed the decision as to the merits of the stories submitted in the air brake story contest recently conducted by them, has just rendered its report, which shows the prize winners to be as follows:

1st Prize, $1,000.00—James Cain, Engineer, Wabash Railroad, Peru, Indiana.

2nd Prize, $500.00—H. C. Woodbridge, General Manager's Special Representative, Buffalo, Rochester & Pittsburgh Railroad, Rochester, N. Y.

3rd Prize, $200.00—Alex M. Stewart, Engineer, Illinois Central Railroad, McComb, Miss.

4th Prize, $150.00—D. Oxenford, Road Foreman of Engines, Lehigh Valley Railroad, New York, N. Y.

5th Prize, $100.00—Carl H. Fuller, Chief Engineer, Macon Railway & Light Company, Macon, Georgia.

6th Prize, $50.00—Millard F. Cox, Asst. Supt., Machinery, Louisville & Nashville Railroad, Louisville, Kentucky.

THE ENGINE SUPPLY ROOM of the Santa Fe at Winslow, Ariz., has a "hot plate" arrangement for keeping oil cans warm during cold weather. A neat bench is constructed of steel plate, and directly beneath the bench top are steam coils. A shelf half-way down also provides a repository for the shorter cans. This shelf keeps the oil ready for immediate use and was installed by M. Weber, master mechanic at that point.

MASTER CAR AND LOCOMOTIVE PAINTERS' CONVENTION.

The forty-fifth annual convention of the Master Car and Locomotive Painters' Association was held at the Hotel Hermitage, Nashville, Tenn., on September 8 to 11, 1914. The meetings were presided over by the president, O. P. Wilkins, master painter of the Norfolk & Western. In his address he called particular attention to the necessity of training young men for the painting department.

The following committee reports were presented:

Finishing Steel Passenger Equipment. Committee—John D. Wright, B. & O. R. R.; A. J. Allen, D. L. & W. Ry.; E. F. Bigelow, N. Y. C. Lines.

Practices in Finishing Wood Interiors of Passenger Coaches. Committee—Samuel E. Breese, L. S. & M. S. Ry.; Arthur R. Given, C. P. R. R.; J. McCarthy, Grand Trunk Ry.

Apprentice Systems for the Paint Shop. Committee—B. E. Miller, D. L. & W. Ry.; Wm. Mullendorf, Ill. Cent. R. R.; M. F. Shaffer, Penn. R. R.

Sand Blasting versus Paint Removers. Committee—W. D. Quest, P. & L. E. Ry.; F. A. Weis, Cent. of N. J.; Wm. M. Joyce, Baldwin Loco. Wks.; J. F. Moore, Erie.

Other questions discussed were: "Rust Inhibitive Paint," "Non-staining Varnish for Locomotive Tanks," "Classification of Interior and Exterior Repairs of Passenger Cars," and "Standardization of Freight Car Lettering."

The association expressed itself in favor of a standard freight car lettering through the following resolution:

"Whereas, The Master Car and Locomotive Painters' Association recognize the advertising value of the trade marks of the railroads that have been in use for years, and realize it would be useless for us to ask them to dispense with this invaluable medium of reaching the public, but

"Whereas, A uniform stenciling of freight cars is very desirable from the standpoint of shop efficiency and economy, and efforts have been made in the past, both by this association and by the M. C. B. Association, to accomplish this end, with more or less success; be it therefore

"Resolved, That we renew our efforts to arrive at this desirable end; and that we appoint a committee to design a series of letters and figures for this purpose, said committee to confer with the M. C. B. Association for its general adoption on all railroads."

The test committee, composed of J. W. Gibbons, H. Hengeveld and A. S. Baldwin, also made a report, showing that their work had proved conclusively that the baking process for plates is more free from checks and retains the luster of the varnish better than the air-drying process.

The following officers were elected for the ensuing year: President, T. J. Hutchinson, Grand Trunk; first vice-president, H. Hengeveld, Atlantic Coast Line; second vice-president, John F. Gearhart, Pennsylvania, and secretary-treasurer, A. P. Dane, Boston & Maine, Reading, Mass. Detroit was favored for the next place of meeting. The secretary reported a membership of 292.

THE JOINT CONGRESSIONAL COMMITTEE on railway mail pay finds the railroads are better paid for serving the express companies than for serving the Government in carrying the mails.

The committee has reported to Congress that the mail service costs the railroads more and yields them less than the express service.

The report holds that the comparison of mail and express receipts furnishes no basis to support the claim that the railroads have been overpaid for carrying the mails.

The committee declares the records of the Interstate Commerce Commission prove "that the express payments have been responsive to the growth in traffic, while the mail payments clearly have not."

The evidence before the committee showed that in a typical passenger train the express car earned $6 while the mail car was earning $5.

Safety Applied to Grinding Wheels

By R. G. Williams, Safety Engineer, Norton Co.

All rapidly moving pieces of machinery present possibility for serious accidents. In view of the fact that grinding wheels are operated at such speeds that the cutting surface travels approximately a mile a minute, due precaution should be exercised, first to eliminate as far as possible, all causes which are known to have been responsible for grinding wheel breakages; and second, to provide adequate means of protection to men and property if wheels are broken from any cause whatsoever.

The manufacturers immediately before packing grinding wheels submit them to a speed test. In a speed test the wheel is revolved at a speed which subjects it to between three and four times the centrifugal stress it will be subjected to under actual working conditions. Defective wheels break under this test.

After completing a test, record is made of the order number, quantity of wheels tested, the specifications as to size, grain, grade, process and speed at which they were tested. Each testing sheet is taken before a justice of the peace and the man doing the testing work is required to swear that he has made a true record of this work. The manufacturer thus has on file a sworn statement of every test made.

Instances are known where wheels have been sufficiently damaged (after they were tested and before being put to use) to weaken them to such an extent that breakage occurred when the wheels were run at ordinary operating speed. Defects which cause wheels to break thus easily can usually be discovered by tapping the wheel a light blow with a small hammer. If the wheel does not give out a clear ring, it should not be used, but the fact should be promptly reported to the manufacturer.

The design and the condition of grinding machines, as well as the foundation on which they rest, are very important and accidents can often be traced to a failure to realize the importance of one or more of these factors.

The modern grinding machine with its heavy spindle, its mass of metal in the base and its long, closely-adjusted bearings is responsible for the elimination of many serious accidents.

Machines should be kept in good condition and should rest on a firm foundation. Machines used for rough work, such as snagging castings, are subject to severe abuse and are seldom kept in good condition. Statistics show that a large majority of grinding wheel accidents occur in foundries, thus emphasizing the importance of the above points.

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* Extracts from a paper read before the Tool Foremen's convention.

GRINDING WHEEL BREAKAGES.

Under this heading are given fifteen various causes for wheel breakages; examples of breakages due to the cause stated and precaution to prevent such breakages.

(1) When the wheel receives a blow while in operation or at rest sufficient either to break it immediately or to weaken it to such an extent that it readily breaks when subjected to working pressure. As an example may be mentioned: permitting work or machine parts to strike wheel on the side. The remedy for breakage of this character is to properly adjust machine parts so that there is not sufficient space between them and the wheel to allow the work to become caught, and proper care on the part of the operator in adjusting machine parts so that the wheel will not be struck a blow.

(2) Improper adjustment of work rest.

The work rest should be adjusted as closely as possible to the grinding wheel as breakages may be caused from something dropping between the rest and the wheel.

(3) The grinding surface of the wheel becomes overheated from excessive forcing of work.

Instances are known where breakage was the result of the grinding surface of the wheel becoming very much heated. Usually the direct cause for such breakages is the fact that the wheel becomes glazed so that excessive pressure is necessary to keep up production. The remedy is to keep the wheel sharp with a dresser or obtain a wheel which is better suited for the operation in question.

Fig. 1 shows a broken wheel in band type protection hood. The breakage of this wheel was due to the grinding surface becoming very hot. The heat did not extend to the center of the wheel and this difference in temperature set up pressure which was sufficient to rupture the wheel.

Serious accidents have happened where large castings are ground while suspended by means of a chain hoist and through carelessness the castings are allowed to strike against the wheel.

Careless handling of the work while being ground, as shown in Fig. 2, is responsible for many grinding wheel breakages. Usually the man performing the operation is not in such a position that he receives injury, but situations of this kind require an adequate safety device to protect other employees from flying fragments of the wheel.

(5) Mounting wheel with one flange and a nut, or using a large flange on one side and a small flange on the other side

Fig. 1.—Wheel Broken by Excessive Heating.

Fig. 2.—Protection of Wheel for Snagging Heavy Castings.

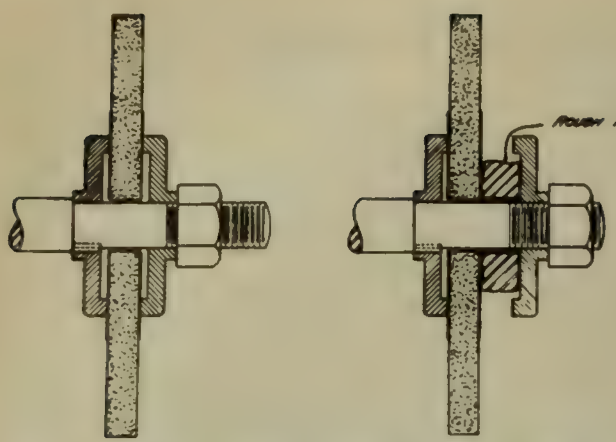


Fig. 4.—Rough Forging Placed on One Side of Wheel Causing Uneven Side Pressure.

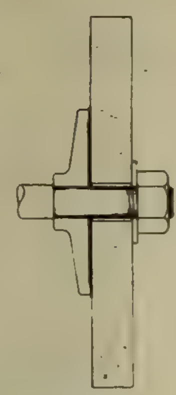


Fig. 3.—Unequal Pressures.

of the wheel. Fig. 3 illustrates a bad practice. The outside flange became lost and the small washer was substituted in its place. This produces such a severe strain on the wheel that it either breaks immediately upon attaining operating speed or soon after it is put to use.

Fig. 4 illustrates how an accident was caused in a factory in the Middle West. The operator had a piece to grind of such shape that the outside flange on the wheel interfered with the free use of the wheel. Without permission from anyone, he removed the nut and the outside flange. He then obtained a rough forged washer in which, for some unknown reason he was very careful to hammer a lead bushing from an old grinding wheel. He then mounted the wheel as shown at the right side of the slide. The man lost his life from the breakage which resulted when he attempted to work on the wheel in this condition. Be sure that the flanges used are of equal size and their diameter equals at least one-half of the diameter of the wheel.

(6) Uneven bearing of flanges on wheels.

This is usually caused by the flanges being damaged to such extent that they lose their original shape; in rare instances flanges have been used which were not machined, but were taken right from the casting in the sand. Such practice brings unequal stresses to bear on the wheel and a breakage is the logical result.

(7) Wheel running out of truth.

This may be due to the hole in the wheel being much too large for the size of spindle, or from the fact that the flanges do not properly hold the wheel. This in turn may be caused by the nut becoming wedged on the spindle before it has been drawn up to the flanges, due either to dirt in the thread of the spindle or in the thread of the nut. The man mounting the wheel gets the impression that he has properly drawn up the flanges against the wheel when such is not the case.

Another cause for wheels running out of truth is directly traceable to lack of proper attention to the machine bearings. The bearings become highly heated, the bearing metal flows, a heavy brake action is produced on the spindle and when the machine is stopped the momentum of the grinding wheel is sufficient to loosen the mounting. When the wheel is started again the nut will not automatically tighten and the wheel will be running under dangerous conditions.

Wheels should not be allowed to remain partly submerged in water, because they will be badly out of balance when started. Some people seem to believe that water has a detrimental effect on grinding wheels. This is not true for the modern grinding wheels; even those bonded by means of silicate bonds are made waterproof.

(8) Inside flange loose on spindle.

The inside flange should either be keyed or pressed on the spindle. Accidents have been known to result from the work being rubbed against a loose inside flange, thus exerting a brake action on the flange, which in turn causes the nut on the spindle to crawl, and in this way enough pressure is exerted on the wheel by the flanges to crush the structure of the wheel.

(9) The wheel screwed on the spindle when the hole in the wheel is too tight to fit. The lead bushing becomes deformed by the wheel being screwed on over the spindle, with the result that each flange only bears on the wheel for a small distance. The remedy is to make sure that the hole in the wheel is of such size that the wheel will slide on the spindle easily.

(10) Wheel breakage due to unrelieved flanges. As an illustration, consider an instance where the operator exerts excessive pressure on the nut when mounting the wheel. This causes straight flange to become slightly convex and concentrates the retaining stresses near the center of the wheel instead of distributing them uniformly throughout the area of the flanges. The remedy for such a situation is to have the flanges (either straight or beveled) relieved to such an extent that a bearing surface approximately $\frac{1}{8}$ of the diameter of the flanges is left near the rim.

(11) Excessive tightening of nut.

By excessive tightening of the nut, sufficient pressure can be set up between the wheel and the flanges to crush the structure of the wheel. It has been calculated that where the size of the spindle is 1½ inches in diameter a man with a 4-foot wrench can exert a pressure between the wheel and the flanges of over a ton and a half. The nut should not be tightened in excess of an amount sufficient to firmly hold the wheel.

(12) Washers too small or none at all used.

Washers of blotting paper or some other compressible medium should be used between the wheels and the flanges. These tend to distribute the stresses set up when the flanges are tightened against the sides of the wheel. These washers should be somewhat larger than the flanges. It is possible for a small piece of metal to become caught in some way between the wheel and the flanges, which, if no compressible washer is used, will cause an excessive strain to be set up at this particular point when the flanges are tightened. The use of compressible washers in such an instance tends to distribute these unequal stresses.

(13) Spindle becoming overheated.

When the spindle becomes overheated the heat is conducted to the lead bushing of the wheel, which may expand to a point where it causes the wheel to break. This can be readily overcome by proper attention to the bearings of the machine.

(14) Wheel running too fast.

A careless workman may so equip the machine that the number of revolutions of the spindle is far too great for the particular size of wheel in use, or it may possibly be that, through a foreman's desire to increase production, he speeds up the wheel so that they will cut faster. Again, where a machine is equipped with cone pulleys and the belt is loose, it is possible for the belt to automatically shift to the small cone pulley and thus greatly increase the speed of the grinding wheel. Sometimes ignorant workmen will mount large wheels on a machine which is equipped and intended for a very much smaller wheel.

(15) Mounting a wheel so that the nut works loose, which will cause the wheel to run badly out of truth.

This can happen in three ways:

A machine is taken apart for repair and when set up the spindle is turned end for end from its original position.

The motor or shafting which drives the machine is changed so that it will revolve in the opposite direction from which it should.

When putting on a new belt an unreliable workman may use a twisted instead of a straight belt.

All of the above mentioned situations can be very easily remedied by a little care on the part of some responsible person. In addition to care, belt locking devices may be used and be so set in the base of the machine as to make it impossible to mount too large a wheel. To further guard against such mistakes, it is a good practice to have a special notice attached to each machine giving information as to the size of the wheel to be used, the number of revolutions per minute at which the wheel should be run, and the class of work for which it should be used.

PROTECTION DEVICES.

There are two acknowledged ways of providing protection to an operator in case the grinding wheel breaks while in operation. One is to surround the wheel, as much as operating conditions

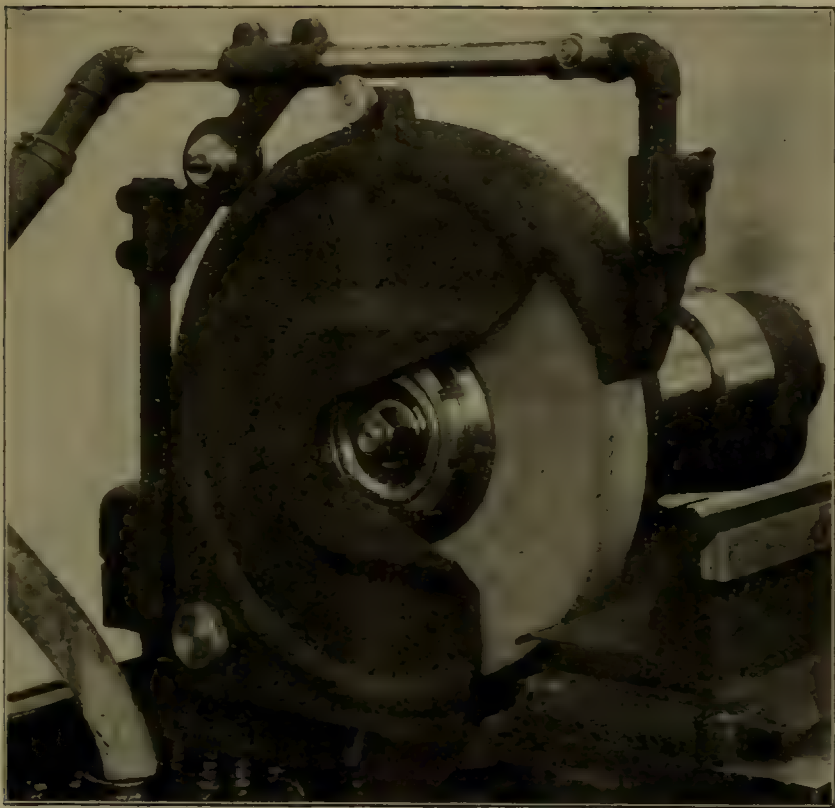


Fig. 5.—Plain Cylindrical Hood Made by Norton Grinding Co.

allow, with a well-designed, substantial protection hood; the other is to use what is known as a beveled wheel in connection with flanges of a corresponding bevel. Beveling a wheel causes it to present a wedge shape and the theory is that should the wheel break the pieces will be retained by the flanges, due to the wheel being thicker at the center than at the point where the outer edges of the flanges bear against the wheel.

The large users of grinding wheels were recently consulted, with the object in view of finding out which type of protection was being used. A good many replies showed a preference for the protection flange method. This was probably due to the fact that such experience as had been had with protection hoods was with designs which were not heavy enough or were made of weak materials. Unfortunately, there are hoods in use today which would not prove adequate in case of accident.

In order to determine the relative value of an approved type of protection hood and approved beveled steel flanges, breaking tests were conducted under actual working speeds.

It was observed that in none of the hood tests did a piece of the wheel leave the hood in a way that could have caused damage. The tests show conclusively that a well-designed protection hood, made of the right material and properly adjusted, affords ample protection for straight-side wheels, even when they are mounted between standard straight relieved flanges one-half the diameter of the wheel.

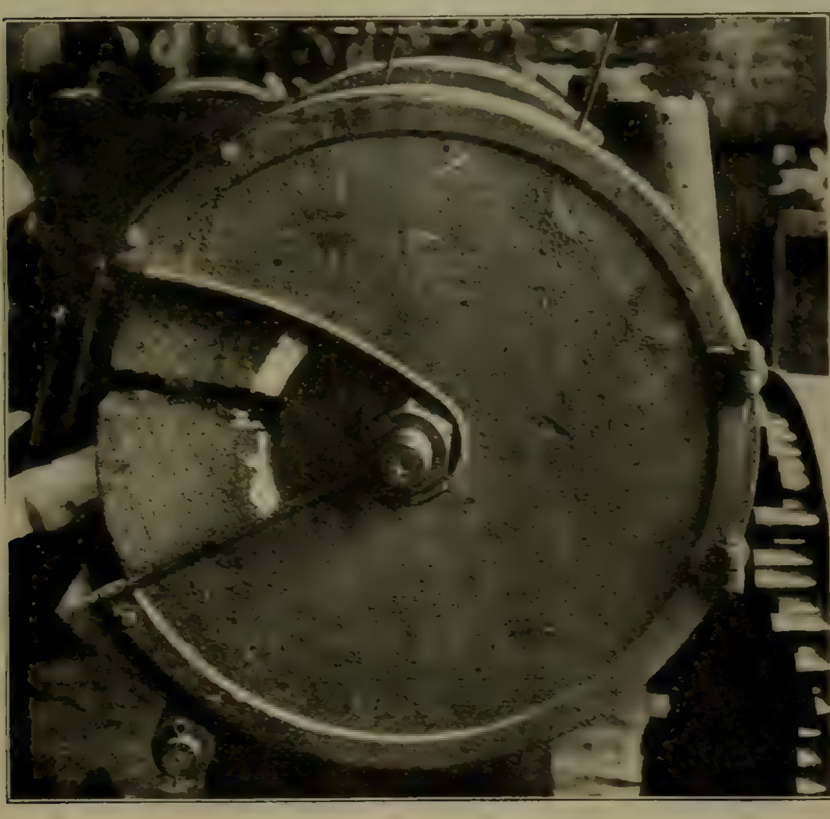


Fig. 6.—Efficient Hood for Floor Stand.

It is possible to break pieces from a wheel by a severe blow when there is only 2 inches of the wheel projecting beyond the flanges. With protection flanges, no matter how little the wheel projects beyond the flanges, an operator has no protection from injury in case a piece of the wheel breaks off outside of the flanges, whereas with a hood protection is almost absolute.

GOGGLES AND SPARK SHIELDS.

There are several satisfactory designs of goggles for grinding, and every operator doing snagging work should be required to wear them. Since the particles cut off by grinding wheels are comparatively small, a heavy type of goggle is not necessary. Goggles should have side guards of wire or leather, as particles coming from one side have been known to enter the eye. A glass spark shield which can be attached to the top of a protection hood is found very satisfactory where wheels are used intermittently; for example, a general purpose wheel in a machine shop. It is recommended that wire glass be used. Glass spark shields have not been found entirely satisfactory where wheels are used continuously, due to the fact that the glass soon becomes pitted from the heated chips of metal.

Another form of protection from grinding wheel sparks is a device consisting of a piece of leather attached to the top end of a protection hood and extending down over the face of the wheel, a slot being cut in the leather the approximate width of the grinding wheel.

DRESSERS.

Grinding wheel dressers are sometimes the cause of accidents. If the work rest is not properly adjusted there is possibility of the dresser being caught between it and the wheel and the revolving cutters sometimes break into pieces large enough to cause serious damage. A type of dresser is recommended which has a hood as an integral part of the handle, the hood serving to protect the user in case the cutters break. The ordinary type of dresser can be made more safe by attaching a thick guard of sheet iron over the cutters.

There is great need for the standardization of grinding wheel protection devices. This subject is to be taken up in the near future by the National Council for Industrial Safety and the National Machine Tool Builders' Association. These two organizations will consider all the important phases of this subject and endeavor to arrive at specifications which can be adopted as standard for protection devices used in connection with grinding wheels.

A WORK REPORT.

Engine No. —. Boar out flese fluse leekin in fire box and frunt end examin her petacot pipe she dont burn her fire only in senter of Box she orter to have a bigger bridge in her noze. Pack rite piston and rite valv stim they are blowin so bad i kant see no kind of signals on my side titen on rite mane wedge and redus left frunt mane rod brass poundin bad, wash out plug in belly of baileer leeking so bad it washes all the oil off the eksentrix on no hoghed can make the reckered on her rase up all around she rides to ruff put a gloab valv in dreen pipe of water glass. Fix qudroon and reech rod so one man hannel the reverse leever it takes me and tallerpot both to get her over. Fix ketch on fire doar so she will sta she burns the fireboy's shins and makes him cuss.—*Troy Chief.*

The Grand Trunk will build a new passenger station and will improve its freight terminals at Black Rock, N. Y. at an estimated cost of $100,000. The contract has been let and the work will begin at once.

OXY-ACETYLENE WELDING AND CUTTING.*

By T. E. Williams, C. & N. W. Ry., Chicago.

There are three general types of oxy-acetylene apparatus in use at the present time, namely:

1. Portable apparatus.
2. Apparatus consisting of an acetylene generator, manifold for attaching oxygen tanks, or a storage tank for oxygen, and a system of piping extended throughout the shop.
3. Apparatus using both oxygen and acetylene generators, with a system of piping.

The field of the portable outfit is in cleaning up wrecks and all sorts of outside iron and steel erecting or raising work. It may also be used in shop work, but is rather clumsy, due to the weight of the tanks used to contain acetylene.

In all around effectiveness, the second type of apparatus is superior for general shop practice. Practically its only drawback is the first cost of the generator, plant and piping system. Once installed, it is extremely flexible in operation. No help is required to move tanks around.

The third type of apparatus is practically the same as the second except that the oxygen as well as the acetylene is generated on the shop grounds. The disadvantage of the system is in the fact that the commercial process of generating oxygen is a very disagreeable one to carry out and requires considerable special apparatus and some skill.

In some cases it has been the practice of the road to put the welding in charge of one of the various foremen, in addition to his other duties. Other roads have a foreman in direct charge of welding, who reports to the general foreman. The force of welders varies in the different shops, both as to the type of men employed and their number. Some roads have taken helpers or handy men and taught them to weld, and some very good welders have been obtained in this way. In other cases the welding force has been taken from the force of shop mechanics. The blacksmith does work which would otherwise have been his; boilermakers do the boiler work; machinists the machine work and steamfitters do the pipe work. The welding foreman in all cases should be a mechanic. Mechanics should make better welders than handymen, as they have a better elementary knowledge of the metals they are handling.

There are two main classes of oxy-acetylene work—welding and cutting. Both welding and cutting may be subdivided into two headings—boiler work and work on castings or forgings. In boiler work the acetylene torch has practically done away with the old method of cutting out sheets or patches by means of an air hammer or drilling holes. The process of welding is put to various uses in boiler work. On some roads running seams, door holes and patches are welded instead of riveted. The economy of the process does not lie in the supplanting of riveting by welding in the boiler shop, but in the roundhouse it is claimed by roads following this practice that the welded seams require less calking than riveted ones. Superheater flues are welded into the tube sheet at the firebox end. Flues which are badly pitted and which would otherwise have to be scrapped may have the pits filled up and thus the life of the flue greatly extended. Grooves in the wrapper sheet at the mud ring may be filled up and the expense of patching saved. The advisability of welding cracks in firebox side sheets seems to be questionable and some roads do not attempt it at all.

On oxy-acetylene work as applied to castings and forgings the cutting occupies only a small portion of the field. It is used mostly to cut away for clearance of bolts or nuts, where the former practice was to drill holes and then chip out the piece. The welding of castings and forgings consists principally of building up places which are subject to wear and have been worn away so much that they can no longer be used, and the welding up of cracks and blow holes. In some cases the cost may be higher to do a job by the acetylene process than by the old method, but the job is enough better to warrant the difference.

The economy possible as a result of oxy-acetylene welding is considerable and varies directly as the quantity of all work handled in a shop. In a large shop six or seven thousand dollars a month is a conservative estimate. Two or three examples will be sufficient to show how the economy is effected. One of the most striking examples is that of building up flat spots on tires, with the following economy:

	Old Method.	New Method.	
Material (turned off tires)	$ 70.00	$3.49	
Labor (changing tires)	30.00	2.72	
Total	$100.00	$6.21	
Saving			$93.79

Another good example is that of a broken spoke in a trailer wheel center:

	Old Method.	New Method.	
Material (scrap val. and welding mat'l)	......	$6.50	
Labor	......	.91	
Total cost	$40.00	$7.41	
Saving			$32.59

In changing from inside to outside steam pipes there is considerable saving possible by burning out the smoke arch hole instead of cutting with an air hammer:

	Old Method.	New Method.	
Material	.....	$0.77	
Labor	$7.50	.30	
Total cost	$7.50	$1.07	
Saving			$6.43

An example of annealing is shown in the case of guide cup holes. These were formerly annealed with a gas torch:

	Old Method.	New Method.	
Material	$1.25	$0.21	
Labor	.25	.33	
Total cost	$1.50	$0.54	
Saving			$0.96

The figures on plugging holes in crosshead shoes which formerly were scrapped are as follows:

	Old Method.	New Method.	
Material	$3.40	$1.41	
Labor	2.46	.61	
Total cost	$5.86	$2.02	
Saving, per shoe			$3.84

The above figures are necessarily approximate, but they are typical of what is possible by the process. There should be means provided, however, so that the true success of the various jobs can be accurately known. The job may look all right when it leaves the shop, but shortly after going into service the welded piece may have to be taken out and a new piece applied. Knowledge of these failures is necessary to the success of the process.

*A paper presented before the International Railroad Master Blacksmiths' Association.

IN EARLY RAILROADING on the South Carolina Railroad, afterwards known as the Charleston & Augusta Railroad, which was completed in 1833, an experiment was tried by equipping one of the cars with a sail, in an attempt to use wind as the motive power. Although the statement has been made that this was the first motive power used on the South Carolina road, that is hardly the fact, as only one car was equipped, and that only as an experiment, it proving entirely unsatisfactory.—*N. Y. Central Bulletin.*

Pacific Type Locomotives, D. L. & W. R. R.

The Delaware, Lackawanna & Western has just received from the Lima Locomotive Corporation fourteen locomotives of the Pacific type for fast freight service. The engines were designed to handle manifest freight trains and resemble with some improvements a similar lot of engines secured for the same service a year ago, and which have proven very satisfactory in service. The principal item of change in the present engines is the introduction of a 36-in. combustion chamber with a consequent reduction of the length of flues. This change has enlarged the boiler at its greatest diameter and increased the weight of the engines slightly. This has doubtless benefited the steaming qualities of the engines and to some extent added slightly to their hauling capacity.

Fast Freight Pacific Type for the D. L. & W. R. R.

Aside from the combustion chamber the engines have a number of interesting improvements. As the engines are frequently expected to do head end work, front couplers are provided with Miner friction draft rigging, which in this type is a very compact and satisfactory arrangement.

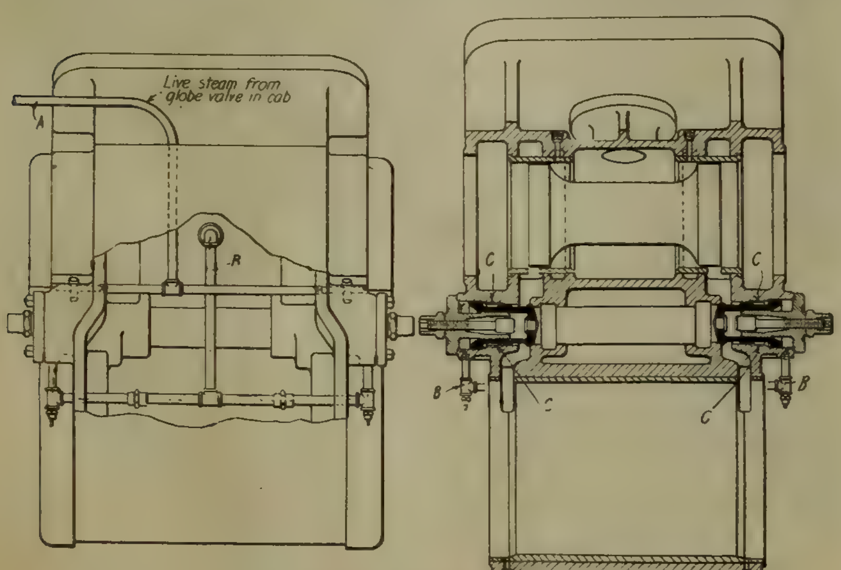
The engine truck is provided with the Woodard inverted link self centering engine truck device; main driving boxes are the long type, 21-in. in length; radial buffers between engine and tender; Franklin butterfly fire doors; Economy type grate shaker brackets which insure against dropping of fuel through the deck; low type tank wells which provide full opening water supply when in use and when closeted permit the water in the tank hose to blow back into the tank so as to leave the hose dry against freezing in winter weather. These tank wells are operated from the ground and entirely dispense with the ordinary upper operating riggings.

The boilers are provided with auxiliary man-hole domes so that the interior of the boilers may be inspected without removal of the throttle valve, and a special form single manifold cab turret is used, so arranged that it can be removed from the boiler for necessary repairs with the full steam pressure on the boiler.

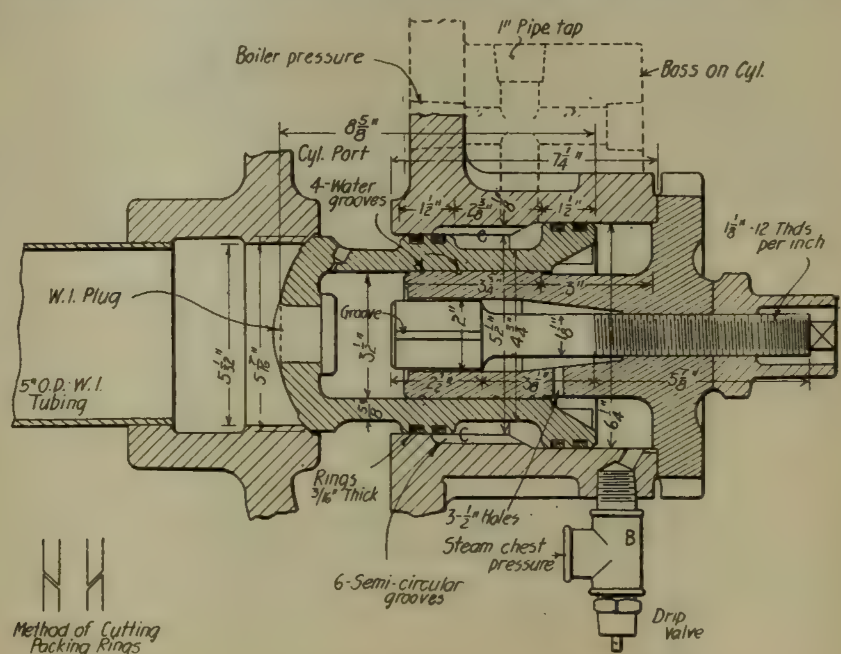
The cylinders are provided with Lackawanna standard by-pass drifting valve arrangement, which provides for the automatic delivery of steam direct from the boiler into the cylinders for coasting periods.

Live steam from a globe valve in the cab enters pipe "A," as indicated in the illustration, and delivers it into the annular chamber surrounding the spool of the by-pass valve. This drifting valve remains open throughout the entire period of engine service; steam from the throttle valve enters from the steam chest into pipe "B" and passes directly into the annular chamber, between the outer end of the by-pass valve and guide spindle cover. When the throttle is opened and engine is using steam, the by-pass valves are held in closed position by the overbalancing steam chest pressure, but when the engine is coasting and throttle steam is shut off, the live steam pressure in the spool of the valve, acting on the larger spool of the by-pass valve, forces it open, causing the packing rings on the smaller or inner piston of this valve to over-travel grooved ports "C," in which position live steam is delivered directly into the entire cylinder space, maintaining an equal pressure on the opposite face of the piston.

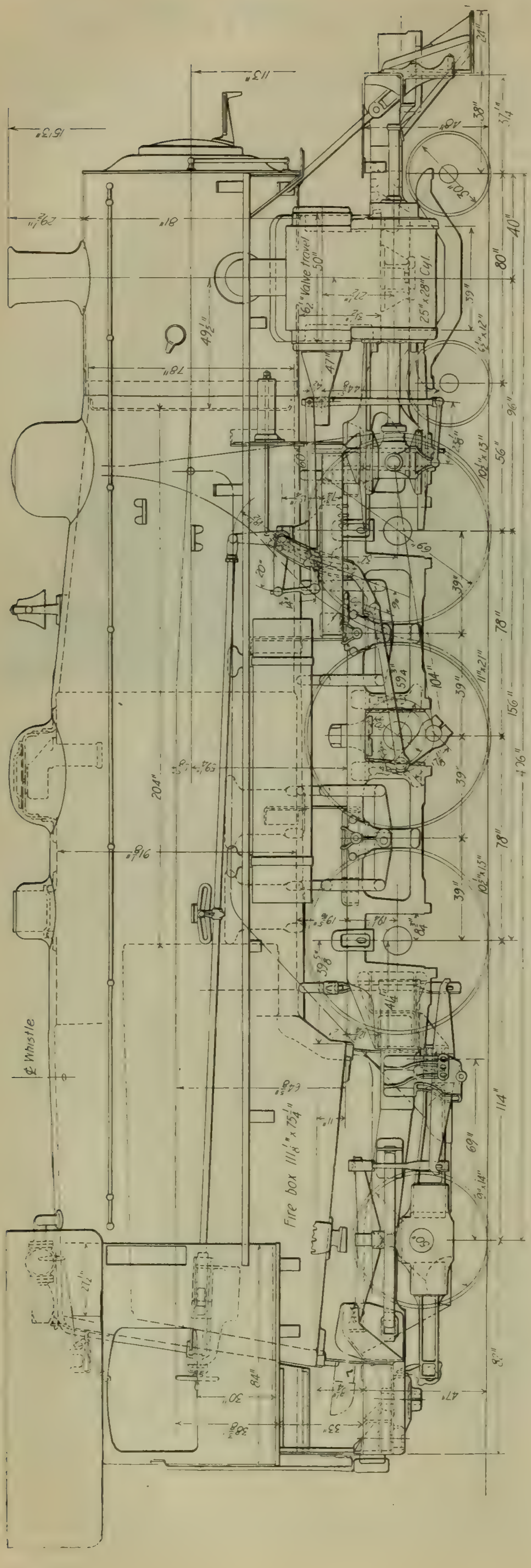
This furnishes sufficient temperature to prevent the chilling of the cylinder, sufficient steam to break up the vacuum during coasting periods and sufficient lubrication to prevent damage to the cylinder walls. This makes the engine very free and easy coasting, avoids carbonization of oil in the cylinder and gives a very great increased life to the cylinder and piston rod packings. The engines perform particularly nice in coasting and the device has done so



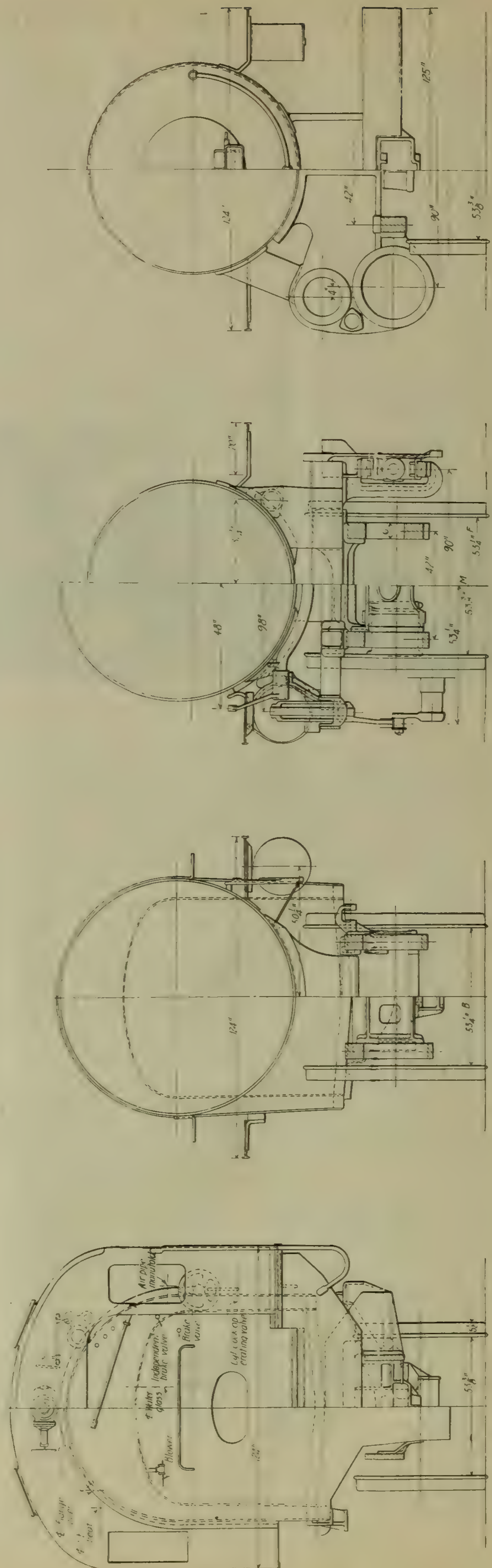
By-Pass Drifting Valve Arrangement.



By-Pass Valve, D. L. & W. R. R.



Elevation of Pacific Type Locomotive, D. L. & W. R. R.



Sections of Pacific Type Locomotive, D. L. & W. R. R.

well in service on other engines that it is considered standard. The device is covered by a patent issued to H. C. Manchester and S. S. Riegel.

One engine in this lot is provided with additional improved features for experimental purposes. These will be described at a later date. The engines are provided with Schmidt superheaters and Security arches supported on arch tubes; Tate flexible staybolts in breaking zones; Everlasting blow-off cocks; Talmage ashpans; Vanadium cast steel frames; Consolidated safety valves; Delco water gauges; Hancock non-lifting injectors; screw type reverse gear; Walschaert valve motion; Westinghouse air brake equipment and two 11" pumps.

The engines were designed under the supervision of H. C. Manchester, superintendent of motive power and equipment.

Other specifications are as follows:

Gauge	4'–8½"
Cylinders	25" x 28"
Tractive power, maximum	43,200 lbs.
Boiler diameter, first course	78"
Boiler diameter, dome course	91⅛"
Boiler pressure	200 lbs.
Fuel	Bituminous coal
Firebox, length	111⅛"
Firebox, width	75¼"
Tubes, number	36–5⅜"; 265–2"
Tubes, length	17 ft.
Heating surface, tubes	3,279 sq. ft.
Heating surface, firebox	279 sq. ft.
Heating surface, total	3,558 sq. ft.
Heating surface, superheater	About 1,000 sq.ft.
Grate area	58 sq. ft.
Driving wheels (over tire)	69"
Wheel base, rigid	13 ft.
Wheel base, engine	33'–10"
Wheel base, engine and tender	66'–4"
Weight on drivers	188,000 lbs.
Weight, tender loaded	165,500 lbs.
Weight, engine	291,000 lbs.
Water capacity	9,000 gal.
Fuel capacity	10 tons

A TRAVELING SHOP MAN.

By H. C. Spicer, Fmn., A. C. L. R. R. Waycross, Ga.

A very important feature in locomotive repair work is the use of the most economical methods and practices in turning out work and at the same time making substantial repairs such as will enable us to get the most possible mileage out of the power when turned out of shop.

A thought which has occurred to me, which I believe would be a paying proposition to be considered by the railroad company, is to appoint a practical shopman to travel over the entire system visiting each shop and having the most economical methods put into practice in the way of making repairs and turning out work in the least possible time. Quite a saving could be accomplished along this line as a man visiting different shops on the system or different shops on other systems could pick up some valuable ideas. Different methods and jigs for doing different operations could be put into practice where the best results could be obtained. It is very often the case that each shop management has its own ideas and methods of doing certain operations and, of course, some of them are very good ones and at the same time others are not so good and are very expensive. There are good many other instances where a man in the position referred to could be of good service. Many instructions are issued from time to time that refer to changing standards and making betterments which do not seem to be fully understood by all concerned, and, of course, there are at times a considerable waste and expense attached. This could be taken care of by a man in the position referred to who could see that instructions of this kind were carried out as intended.

I am sure it is the desire of the railways to get the best possible results in the saving of time and labor for the money expended. I am satisfied this would be one position that would well pay for its maintenance, should it be inaugurated. It is a well known fact that a foreman confined to one shop and never visiting other shops cannot take care of this feature as well as a special man who visits other points and makes it his business to look after these saving features.

RAILWAY EDUCATIONAL BUREAU.

For four or five years the Union Pacific, Illinois Central and the Central of Georgia maintained an educational bureau and correspondence school for the benefit of their employes. Its work was very successful but on account of the necessity of economy, it was decided to reorganize the bureau on a permanent and self-sustaining basis and this was done on July 1, 1913. The bureau was located at the Union Pacific headquarters at Omaha, Neb., and D. C. Buell, who had been in charge of the original bureau, was made director. No railway official has any financial interest in the bureau and the work was turned over to Mr. Buell with the understanding that he was to make a fair living out of the work and apply any excess profits to increasing the efficiency of the bureau.

From careful records kept during the period when the bureau was under the management of the roads mentioned, it was decided that the work could be continued by making a charge of $1 a month to its students, which entitles the subscriber to instruction in as many branches as he desires. The bureau does not sell courses, but simply requires a subscription for a 12 month period, necessitating an outlay of but $12. The bureau already has the support of a large number of roads and with the addition of a few more it is hoped to cut this subscription period down to 6 months. Often students subscribe to expensive courses which they later find they cannot use, but by this method the subscriber risks only a small amount to determine if the work will benefit him.

Arrangements have been made with roads in which the road indicates a willingness to have its employes sign orders whereby the company deducts the amount of the subscription from their pay checks, in favor of the Railway Educational Bureau. All of the roads interested have co-operated with the bureau in every way.

The work of the bureau has been extended to the following lines, besides the Union Pacific, Illinois Central and Central of Georgia:

Oregon Short Line; Oregon-Washington Railroad & Navigation Company; San Pedro, Los Angeles & Salt Lake; St. Joseph & Grand Island; Ann Arbor Railroad; Wadley Southern; Wrightsville & Tennille; Georgia; Atlanta, Birmingham & Atlantic; Western Railway of Alabama; Atlanta & West Point; Southern Pacific, Sunset-Central Lines; Morgan's Louisiana & Texas R. R. & S. S. Company; Louisiana Western; Arizona Eastern; Southern Pacific of Mexico; Georgia & Florida; Manistique & Lake Superior; Georgia, Florida & Alabama; Sumpter Valley; Spokane International; Texas South-Eastern; Chicago Great Western; Chicago, Indianapolis & Louisville.

Courses are offered in the following subjects: Air brake, locomotive, mechanical drawing, machine design, mechanical engineering, gas engine, shop practice, tool making, pipe fitting, plumbing, railroad operation, block signaling, interlocking, station work, refrigeration, traffic, track work, concrete, surveying, mapping, mathematics, electrical engineering, sheet metal pattern drafting, boiler layout work.

The aim of the bureau is to offer instruction at such a reasonable figure that any ambitious employee can take advantage of it; to provide as much instruction as possible and to eliminate the man who will not study, at the least possible loss.

The Atlantic Coast Line has started work on additions to the shops at Waycross, Ga.

The Baltimore & Ohio will reconstruct the Lancaster Ave. bridge at Wilmington, Del.

ISSUING INSTRUCTIONS TO SUBORDINATES.

By Louis Brentnall.

While shop foremen may give timely verbal instructions to workmen when directly supervising their work, yet railroad officers must generally issue their orders in writing, so that same may become a matter of record. It is therefore essential that the master mechanic should adopt some systematic method of issuing written orders and filing copies thereof for future reference, as many of these orders may continue in effect for years, while others may require revision from time to time on account of changed conditions, and possibly a few of them will have to be cancelled by reason of the matters to which they refer becoming obsolete.

The need of systematizing the mode of issuing instructions is the more apparent when it is considered that most master mechanics have mechanical supervision over divisional territory which may include a number of shops, roundhouses, general foremen and assistant master mechanics rather than merely over a mile of territory or a single shop.

However, a master mechanic should be careful not to tie his subordinates down with various instructions so voluminous that the men are afraid to move without consulting his portfolio of orders, else they may suffer from paresis or become nonenities. One Bottkins, who was more of an officeman than an officer, controlled his men by issuing memorandums and compendiums pertaining to every detail of mechanical service, with the result that none of the men could act without first running to their desks and referring to the master mechanic's favorite instructions. When the general manager visited the shop and asked a question, the foreman had to peep at the master mechanic's circular before he could answer it. And yet Bottkins wondered why his men exhibited no originality!

As a first step toward systematizing his mode of issuing instructions, a master mechanic may classify the orders he issues into three classes—educational, imperative, special.

Educational instructions of an informative character may be issued in the form of circulars or general letters which bear consecutive numbers or are identified by special subject headings. If a master mechanic wishes to issue some special instructions as to how a crane should be handled, or how locomotives shall be wiped in the roundhouse—instructions which will probably continue in force for years—he may include same in a circular. In so doing he simply requires his foremen or workmen to embody into their practice certain well recommended features which had not previously been observed. It is unnecessary, of course, to tell an engine wiper every turn he should make, as such details only beggar the instructions by making the workmen headless, like Bottkins' men. Again, a new system of timekeeping may have been installed, such as changing from a check plan to a clock system, and the easiest way to systematize the operation of the new method is by issuing an informative circular to all concerned. General instructions may also be issued by general letters when only a few parties are concerned therein.

Imperative instructions are usually issued through regularly dictated letters. These may be informative as well as instructive. The first paragraph of the letter may state in concise form that which must be done, the time in which it should be accomplished and the necessity for the work. Some master mechanics may prefer to "keep under their hats" the reasons for requiring work to be done, but in such cases the workmen sometimes imagine that something unexpected will be the outcome and consequently they may fear a ghost when none is to appear. The second paragraph of the instructions may tell, in the main, how the work should be done, leaving minor details to the best judgment of the foreman. The last paragraph of the letter should require an acknowledgment of the receipt of the instructions and precautions should be taken to see that all replies are received, inasmuch as letters or papers are sometimes lost in the mails.

Special instructions are generally handled by wire. Frequently there is no time to wait, and answers must be made promptly. Telegrams can be considerably shortened by first writing rough copy at length and placing an underline under each important feature, and afterwards rewriting the telegram in abbreviated form so as to include only these main features. Special instructions should be confirmed by letter, but instead of writing a letter immediately after sending a telegram it is sometimes best to wait for the answer and then state the whole case at one stroke.

In issuing special instructions—or, in fact, any instructions—considerable depends upon good indexing in order to later locate the filed papers. It is usually best to divide the indexing as pertaining to the several departments—car shop, locomotive shop, coach shop, etc. Matters pertaining to car department may be designated as series "1," those pertaining to lomotive department as file "2," and so on. In addition each letter or telegram may bear an individual file number, as "33–1." The prefixed number "33" is the special subject number, while "1" shows that the subject refers to the car department. It is much easier to locate a file in this way than where various correspondence is filed in a bunch. Thus, when the master mechanic wants the papers in a certain matter he need simply tell the officeboy, "Bring the papers about that car shop planing machine." The boy knows right away that they are in file division numbered "1," and need only look for the special subject number which was given to "planing machine."

Verbal instructions may precede special or written instructions. The master mechanic may be directed by the general manager to take the president's car into the paint shop for revarnishing and have it ready for service in ten days, whereupon the master mechanic may 'phone the superintendent to set the car at the shop and at the same time inform the master painter that the car should be taken into shop at once. He may then write a letter reiterating his orders.

The usefulness of the master mechanic's circulars is illustrated by the fact that a year after a circular has been issued his attention may be called to some delinquency which refers to a circular which had previously been issued, and therefore instead of issuing a new circular he need simply write a letter calling attention to the one which is not being observed.

Where there is no particular hurry about sending out a circular, and a large number of them are required, it is preferable to have a local job printer handle the printing, for the reason that such circulars look well and cost only two or three dollars a thousand—which is cheaper than a master mechanic can run them off on a duplicating machine. However, a duplicate machine is required in every master mechanic's office. The mimeograph, which produces non-fading copy, is an excellent duplicating machine, although for ordinary use there are many other meritorius duplicators. One trouble with ribbon duplicating machines is that some of the copies are dim or become faded in time, and therefore such duplicates are generally used for temporary instructions only.

Inasmuch as the issuing of instructions to subordinates includes all correspondence, as well as circulars, which enters or leaves the master mechanic's office, each set of incoming papers should be given a file number before reaching the front room, and this same file number should be placed on the letters or circulars dictated by the master mechanic.

A master mechanic's best help in issuing written instructions is a good stenographer, who becomes proficient not so much from knowing "pot hooks," but rather from his ability to grasp the meaning of mechanical subjects, which he acquires through practice and experience, therefore a good commercial stenographer might not become a good railroad stenographer. Again, editorial revision is required as regards some letters that master mechanics dictate while in a hurry, and the stenographer should be given to understand that he is to better

the verbiage when possible to do so or where revision is required. The master mechanic's stenographer should be one who has really had mechanical department experience, as a stenographer who is promoted from a foreman's office. He should know all the master mechanic's foremen, their general duties and general matters pertaining to the master mechanic's territory, so that when the master mechanic dictates instructions the stenographer will be able to comprehend their import.

Strange though it may seem, yet years ago there was less necessity for issuing instructions than there is today. In the olden times foremen were depended upon to not only perform their regular duties but to act as assistant master mechanics, going ahead and making changes and betterments without waiting for instructions, but such foremen are a scarcity today. The master mechanic, however, is not to blame, as he no doubt has instructions from his superiors not to do thus or so, and of course under such conditions the foremen can take little action without first obtaining instructions from the master mechanic. In those days, when the master mechanic had a foreman at an outside point, he knew he could depend upon him to run things without instructions, whereas today he must instruct him as to what to do, and sometimes he must tell him how to do it.

FORGING FRONT-END BRACES.

By Arthur Bennett, Genl. Fmn. Blks., C. M. & St. P. Ry., Milwaukee, Wis.

At our Milwaukee shops we forge these braces complete in four operations on a 4″ Ajax forging machine and make a set of braces in three hours. The heating is done in coke furnaces. This brace is one of the largest forgings we make in this machine. The top part is made in two operations with two sets of dies and one header. The first operation is to upset from 2½″ diameter to a round ball. Half of this ball is formed in the header and the other half in the dies, with stock enough to make the head. The second operation is made in the dies, pressing to the proper shape. The foot is also made in two operations from the same stock. The first operation is made in the header by upsetting and shaping and the second operation is made by another set of dies where it is pressed and forged to size. This brace is made from 2½″ round bar iron cut long enough to forge the head on one end and the foot on the other. To avoid welding, this work is forged and finished ready for use at the forging machine.

CARS DESTROYED IN ACCIDENTS.

The following table taken from the Baltimore & Ohio Employes' Magazine shows the number of cars destroyed in accidents on the Baltimore & Ohio Lines during the past five fiscal years, and their value. It will be noted that there has been a decided increase in the last two years. This condition is more or less true of all roads, and the comment following the table in the magazine referred to will bear thinking over.

Fiscal Year	Baltimore & Ohio: Cars: Number Destroyed	Baltimore & Ohio: Cars: Per cent. Increase over 1910	Baltimore & Ohio: Net Value: Cars when Destroyed	Baltimore & Ohio: Net Value: Per cent. Increase over 1910	Baltimore & Ohio Southwestern: Cars: Number Destroyed	Baltimore & Ohio Southwestern: Cars: Per cent. Increase over 1910	Baltimore & Ohio Southwestern: Net Value: Cars when Destroyed	Baltimore & Ohio Southwestern: Net Value: Per cent. Increase over 1910	Cincinnati, Hamilton and Dayton: Cars: Number Destroyed	Cincinnati, Hamilton and Dayton: Cars: Per cent. Increase over 1910	Cincinnati, Hamilton and Dayton: Net Value: Cars when Destroyed	Cincinnati, Hamilton and Dayton: Net Value: Per cent. Increase over 1910
1910	518	.....	$ 99,790	.....	53	.....	$10,359	.....	19	.....	$3,902	.....
1911	770	48.65	123,885	24.05	104	96.23	20,631	99.16	59	210.53	4,253	9.00
1912	804	55.21	147,877	48.19	116	118.87	15,311	47.80	40	110.53	5,806	48.80
1913	1,697	227.61	268,727	169.29	227	328.30	29,581	185.56	16	*15.79	2,160	*44.64
1914	1,831	253.47	350,548	251.29	507	856.60	74,107	615.39	40	110.53	5,370	37.62

* Indicates decrease.

"The cooperation of all employes is earnestly requested in reducing this appalling loss by more careful handling of cars. An improvement along this line will help cut down damage to freight—will prevent interference to traffic and inconvenience and expense in switching—and will reduce the number of shop cars and a consequent loss in revenue service. All these factors in operating expenses can be improved materially if all of us will lend a hand."

MISPRONOUNCING SANTA FE.

It comes as a shock to any properly informed Santa Fe employe to hear someone else in the service pronounce the name of the road he works for as if spelled Santa Fee (two es in the second word instead of one). No wonder many outsiders mispronounce the name of our railroad. There is absolutely no reason why "Fe" should be pronounced as "Fee." "Santa Fe" is Spanish for "Holy Faith," and the "Fe" is pronounced as if spelled "Fay."

Not long ago we heard a brakeman who had been in the employ of the road nearly twenty years standing on a depot platform calling, "Santa Fee going west." In all probability the matter of the correct pronunciation of the name of the road printed on his paycheck never had been brought specifically to his attention; but he certainly should have been bright enough to pick up the proper pronunciation at some time during those twenty years.

Don't let any others among us display such ignorance before those whom we address. A prospective patron is sure to feel that a man who doesn't know how to pronounce the name of the road for which he works isn't apt to know much more about the road in any other particular.—*The Santa Fe Magazine.*

AS INDIA SEES US.

The amount of detail that is now being introduced into the administration of American railways is no doubt the chief factor in their successful working, the basis, we may say, of the reputation they are slowly earning of being really first class business concerns. It is not so many years ago that those railways were best known for the number of accidents that occurred on them, for the laxity of discipline among the staff, for the rough-and-ready tracks that were made to do duty, for cheaply and flimsily built locomotives that ran to scrap in one-half the time of a first class engine of British construction. Behind it all, however, there was the business instinct that got the best out of all these apparent disadvantages and eliminated them all one by one, as soon as it began to "pay" to do so. At the present day attention is being turned to small details in an endeavor to turn the working of railways inside out, as it were, and extract from each system the last grain of efficiency it may be expected to contain. In other words, the working of American railways is growing to be intensive, just as agriculture has become by the application of scientific methods.—*Indian Engineering*, of Calcutta.

CLEAR the TRACK
FOR THE
LOCOMOTIVE!

All persons are notified that on and after MONDAY, the 19th of APRIL, the Main Track of the

THE SWATARA & UNION RAIL ROADS,

Must be kept clear EVERY DAY,

FROM FOUR TO FIVE O'CLOCK IN THE MORNING,

AND ALSO FROM FOUR TO FIVE O'CLOCK, IN THE AFTERNOON,

To afford a passage for the Locomotive and Passenger train to run during those hours between Pinegrove and Tremont. Neglect of this notice will be visited with the utmost penalty of the Law.

JAMES WORRALL,
ENG'R. UNION CANAL CO.

PINEGROVE, APRIL 9th., 1852.

Copy of a Poster Used in the Early Days of Railroading. (From "The Pilot.") There Were Trespassers in Those Days.

ANOTHER SHOP INCIDENT.

By Frank Phelps.

Here is the explanation of Nate Wright's problem in the article "A Threshing Machine Machinist," published on page 222 of the June issue: When Wright started to put up the left side of the link motion he lined up the eccentrics on the left side with the ones on the right side, regardless of the pin in the left driving wheel, which caused the two cylinders to pull against each other at certain points of the revolutions of the drivers.

Another funny incident took place in the same shop while I was there. The gang boss that I was working under and the one on an adjoining pit were both rebuilding the same kind of engine, an eight wheeler, only one was 22-inch stroke of piston with 5-foot drivers, and the other was 24-inch stroke and 5-foot 6-inch drivers. The engine on the other pit was ready for her wheels before my boss got ready fot the wheels for our engine, so they went out behind the shop and got two pair of the wheels put out there from the wheel lathe after the tires were turned up.

They put the wheels under the boiler, let her down, put up the pedestal braces and went to tram her up to put on the side rods. When they trammed up one side by the axles and set the pins on that side and went around to the other side the axles trammed up all right, but the pins were an inch out of tram.

Smith, the gang boss, scratched his head and tried it again, but with the same result. Then they pinched the engine ahead a quarter turn of her wheels and she trammed all right on that side, but when they went back to the side where they started from the axles trammed all right but the pins were out an inch.

By the time that they had tried both sides several times Smith was scratching his head with both hands.

When Smith had got good and warm under the collar my gang boss saw that something was wrong and went over.

Smith showed him that the axles and pins on the left side trammed up all right and then they went around to the right side, where the engine was on one of the centers. They tried the tram on the axles and they were all right, but when the tram was put on the pins they were found to be an inch out.

When my boss saw that he looked closer at the wheels and commenced to laugh, Smith wanted to know what he was laughing about. He slapped Smith on the back and said: "Look here, Smith, the farmers out in the country where I was raised knew enough to put the small wheels on the front axles of their wagons." Smith wanted to know what he meant by that, and then he showed him they had a pair of wheels that did not belong to the engine at all. The cubs and laborers had not noticed the difference in the size of the wheels, as they were so near the same height and had got mixed up after coming from the wheel lathe. They had put the largest pair in front. Of course the perfectos were on Smith.

WHAT THE INJURED PERSON SAID.

The Baltimore & Ohio has a printed accident report form, on which foremen are required to report mishaps which befall their men. One of the questions is: "What does the injured person say?"

Some of the road's carpenters were working on a bridge over the Chicago river, and one of them fell off. On the report in the office was the following:

"What does the injured person say?"

"He says it was a damn good thing he could swim."—R. G. C. in *The Chicago Tribune.*

The Chicago, Rock Island & Pacific and the city of Muscatine, Ia., will build a bridge on Monroe street.

The Corvallis & Eastern bridge over Mary's river, four miles east of Philomath, Ore., was entirely destroyed by fire recently.

EVENING SCHOOL OF ENGINEERING.

The evening school of engineering giving graduate courses will be a new feature introduced into the University of Pittsburgh this autumn by Dean F. L. Bishop. It is the first time this kind of work has been attempted in this country, although several day schools offer graduate work. For instance, Harvard established a graduate school five years ago, but it was not successful because men could not afford to take time from their engineering work to attend these advanced courses.

In the Pittsburgh district, there are more engineering graduates than in any equal district in the United States. It is for this reason that the University of Pittsburgh will provide for men who do engineering work during the day an opportunity to study engineering in the evening. Men who are properly prepared and who have received their bachelor of science degree may obtain an engineering degree from the University of Pittsburgh.

Many young engineers find after engaging in practical work that the courses which they took in college did not fully prepare them for their duties. Few of them have opportunity to quit work and go back to their own college for further study, but many of them can devote their evenings to new courses. It was recently stated by a prominent engineer that evening graduate courses of this kind are the only graduate courses in engineering that will prove successful.

Courses will be offered in the valuation of public utilities, mechanical, civil, electrical, sanitary, mechanical raliway, concrete engineering, etc. The faculty will include some of the best engineers in the Pittsburgh district. For instance, Paul M. Lincoln, professor of electrical engineering, University of Pittsburgh, president of the American Institute of Electrical Engineers, and consulting engineer of the Westinghouse Electric and Manufacturing Company, will give a course in power plants. Mr. Lincoln was formerly chief engineer of the Niagara Falls Power Company. Another lecturer is Louis E. Endsley, professor of Mechanical Railway Engineering in the University of Pittsburgh, formerly professor and head of the Department of Mechanical Railway Engineering in Purdue University. He is a member of the Master Car Builders' Association, American Master Mechanics' Association, and a member of the Committee on Standard Testing of Locomotives for the American Master Mechanics' Association. Mr. Endsley is also a member of the Technical Board of Detail of the American Efficiency Survey of Motor Car Units, which is attempting to standardize all automobile parts. He has recently completed some experiments on the Pennsylvania Railroad dealing with new features in steel car design. D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West and director of the department of mechanical railway engineering, University of Pittsburgh, will co-operate with Professor Endsley in the work of Mechanical railway engineering. Professor R. T. Stewart, head of the department of mechanical engineering, University of Pittsburgh, and consulting engineer of the National Tube Company, will offer a course. Professor J. Hammond Smith, head of the department of civil engineering, will give courses in structural engineering. Professor Morris Knowles, director of the department of sanitary engineering, together with Professor G. W. Case and William S. Moorehead, Esq., will give the course in the valuation of public utilities. This course was given for the first time in this country last year and the resultant demand was so large that it has been made a permanent feature of the work.

Miss Marguerete Gainey, sister of J. J. Gainey, general car foreman of the Queen & Crescent at Ludlow, Ky., passed away recently. Miss Gainey was a regular attendant at both the Master Car Builders' and the Chief Interchange Car Inspectors' & Car Foremen's Associations and was known to many of the members.

A study of the properties and needs of the Denver & Rio Grande and Western Pacific has been completed by John F. Stevens. A readjustment of the affairs of the latter road is about to be undertaken by a syndicate of New York bankers, who probably will provide funds for new construction work.

SHOP KINKS, CANADIAN NORTHERN RY.

A piston extractor of unusual strength and one which will draw pistons without damaging the crosshead is shown in Fig. 1. This is in use on the Canadian Northern Ry. It is entirely made of $\frac{1}{2}$" boiler plate shaped to suit contour of piston rod. The piston is first drawn back to its striking point and the long two-piece sleeve is applied to the rod, bearing against the packing gland. The two collars are then applied at the crosshead end of the rod, the halves being held together by $\frac{5}{8}$" bolts. Taper keys are driven in the ways between the collars to draw the piston.

Fig. 2 shows a cylinder head truck which is very cheap and effective. It is made of $\frac{3}{8}$" sheet metal and has a slot down the center, on either side of which are $\frac{7}{8}$" holes to allow for the insertion of an adjusting device, as shown.

Fig. 3 shows a device for turning driving wheels when valves are being set.

The bed plate is of cast iron with roller trunnions of same material, all machined out $\frac{3}{8}$" deep and $2\frac{1}{2}$" wide to take top of rail, and are designed to suit a tire of $6\frac{1}{2}$" width maximum.

Three rollers are of cast iron, having a chilled face with corners rounded off to $1\frac{1}{8}$" radius, to fit snugly against tread and flange of wheel. The fourth roller is of same outside diameter, viz., $7\frac{1}{4}$", but of O. H. steel, case hardened, having 91 teeth cut in face $\frac{3}{16}$" deep and $\frac{1}{4}$" C. P. The smooth-faced rollers work on case hardened steel roller bearings $\frac{3}{8}$" diameter and $2\frac{1}{8}$" long, held in place by double collars, case hardened, of steel $\frac{1}{16}$" thick. The toothed roller is keyed to main operating shaft, which operates in the bed plate. Three of the rollers work independently in their respective trunnions and are fitted over a small case hardened steel axle $2\frac{3}{16}$" diameter and $7\frac{1}{3}\frac{5}{2}$" long, having ends tapered for $\frac{1}{2}$" machine screws, taking a $3\frac{1}{2}$" diameter washer $\frac{3}{8}$" thick, for securing shaft in place. The trunnions and bed plate are all secured through a system of four 1" diameter tie rods having 12" threaded portion at one end to suit various sizes of wheel diameters.

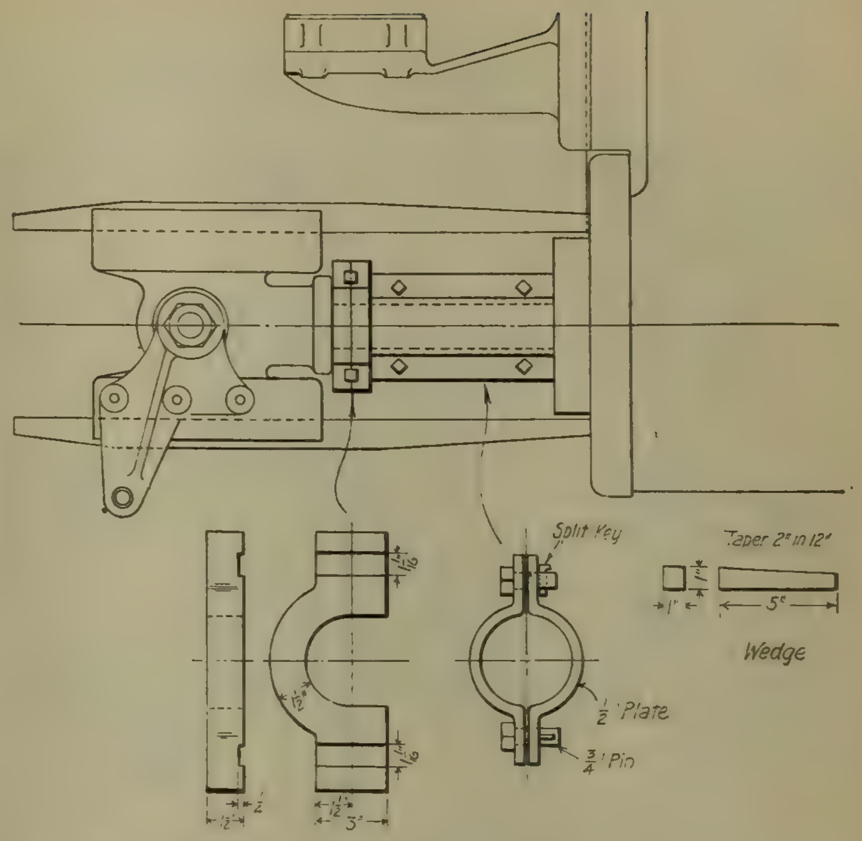


Fig. 1.—Piston Rod Extractor, C. N. R.

A combination $1\frac{1}{4}$" diameter shaft made of O. H. steel and having $4\frac{1}{4}$" worm section $2\frac{1}{2}$" outside diameter, with six teeth $1\frac{1}{3}$ teeth per 1" R. H. Thread is extended out on one side and meshes into a bronze worm gear having a diameter of 9.549" $1\frac{1}{3}$ teeth per inch, $\frac{3}{4}$" C. P., making a total of 39 teeth per gear, which is keyed stationary to the $2\frac{3}{16}$" diameter main shaft.

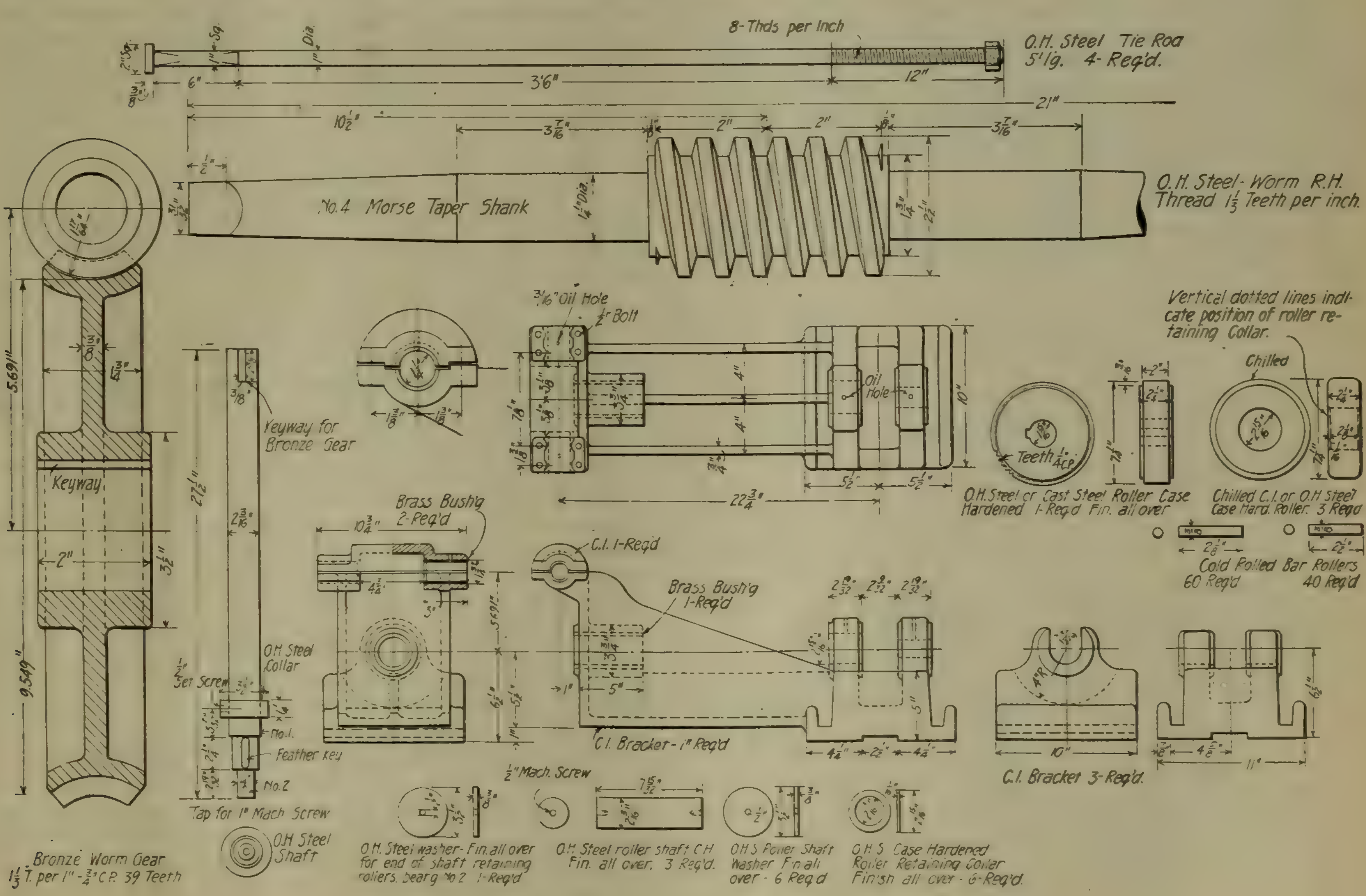


Fig. 3.—Details of Valve Setting Machine, Canadian Northern Ry.

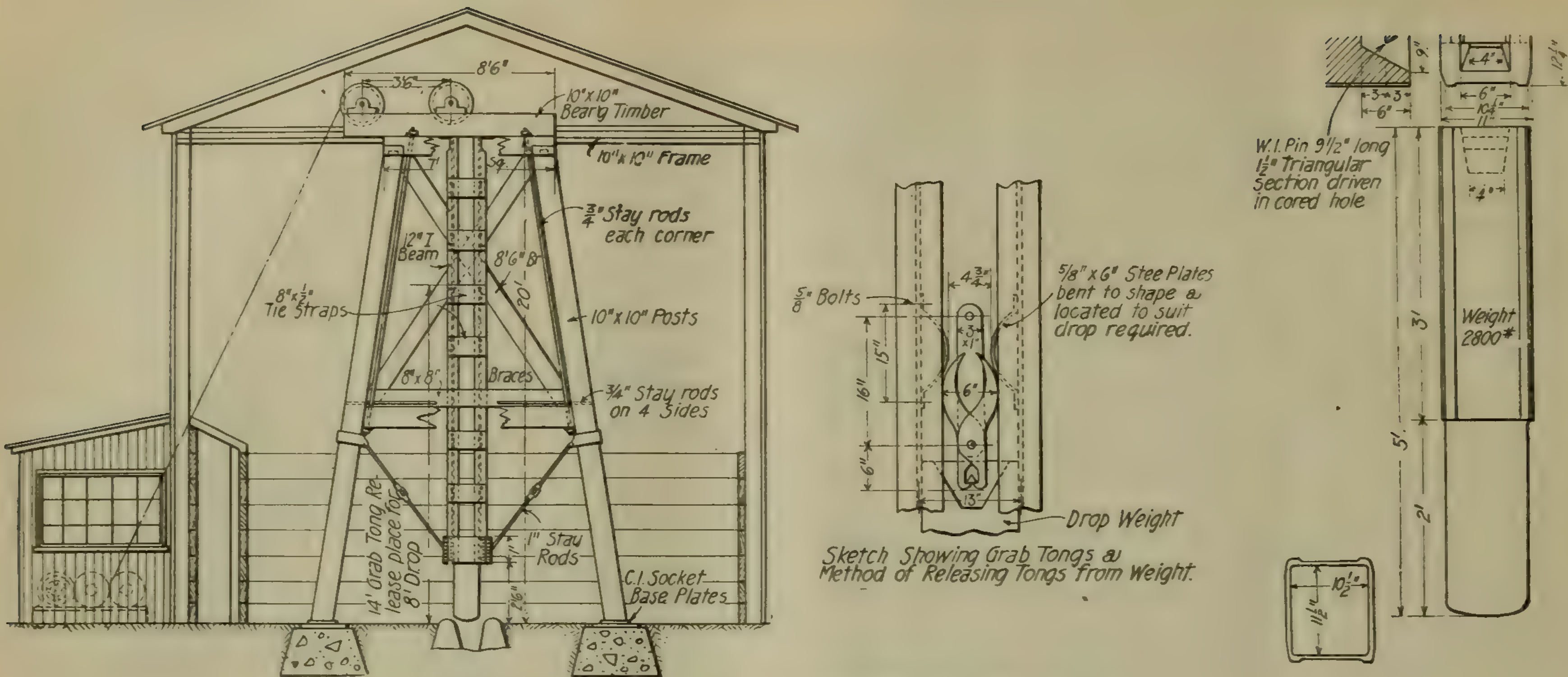


Fig. 4.—Wheel Testing Machine, Canadian Northern Ry.

The stem of the worm is made of No. 4 Morse shank contour to fit an air motor, which may be attached and used as a driver.

The advantage of this arrangement is that the operating mechanism is out to the side and in plain view of the men working the device, which is not the case with most machines of this character. Aside from this the arrangement is simple to install, as in disconnecting the only parts requiring adjustment are the tie rods, and these are fitted up to suit the diameter of the wheel. Where it is impossible to machine a worm as shown same may be made of cast steel.

Fig. 4 shows the details of a wheel testing machine, an interesting feature of which is the grab tongs and method of releasing them. They are fashioned something like a pair of pliers and when the portion corresponding to the handles passes between two curved steel plates the handles are passed together, thus releasing the weight. The other ends of the "pliers" catch under a three-sided bar, which is inserted in a recess at the upper end of the weight.

The building is constructed of 1" sheathing and has a 3" spruce lining to a height of 8 feet. The peep opening in the operator's cage, shown at one side, is covered with heavy wire netting. An industrial track passes through the building at one side of the testing machine.

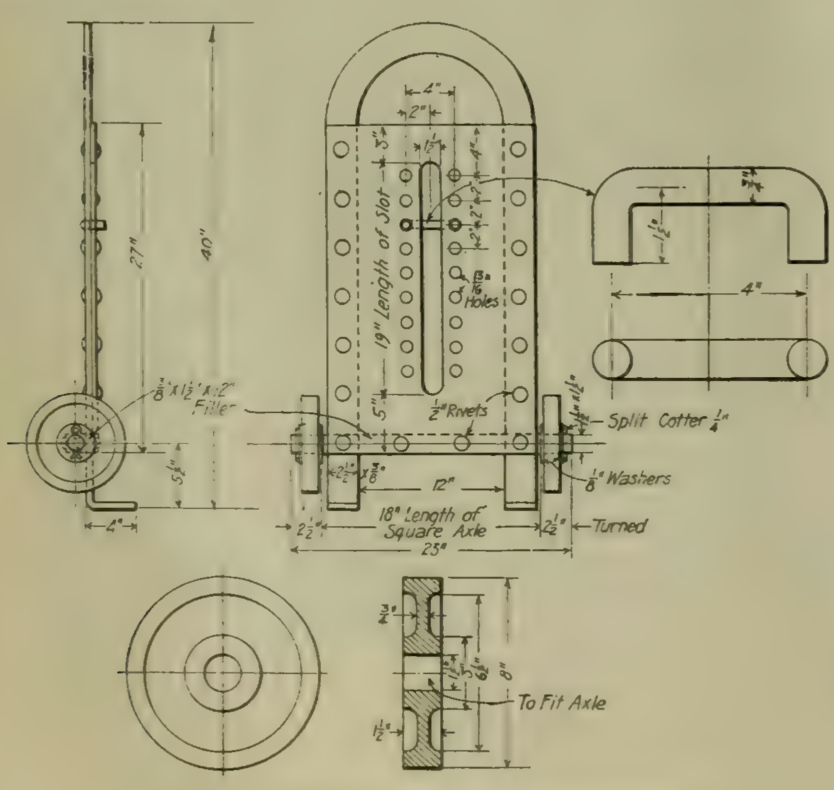


Fig. 2.—Cylinder Head Truck, C. N. R.

SAFETY FIRST.

An amusing story of a "Safety First" button was recently published in a Chicago newspaper. Henry Spieckerman, of the auditing department of the Chicago Milwaukee & St. Paul, owes his life to the fact that he accidentally swallowed his "Safety First" button as he was straightening out the fastener with his teeth. The button could be removed only by an operation during the course of which it was discovered that Mr. Spieckerman's appendix was so diseased that his life was in danger. The surgeon who removed both button and appendix asserted that if Mr. Spieckerman had not swallowed the button, he would have died within a month.

SIT TIGHT! DON'T ROCK THE BOAT.

Sit tight! Don't rock the boat! That's the watchword today. That's the first duty of every American at this moment. That's what this country needs to keep it straight and safe and true to its course—absolutely all it needs.

Business conditions are sound. We have one of the greatest grain crops in history. Its value has already greatly advanced. We have a sound financial system, backed by the greatest store of gold in the world. Our banks are solid, safe. There is nothing the matter with the United States.

War will mean an unprecedented demand for supplies. Experts declare American business will feel a great impetus. While other nations destroy, this country will produce. While other nations are armed camps, this country will be a farm, a factory, a forge. Trade extension is predicted in all directions.

Don't rock the boat—that's the central idea! The swell from the great battleship "Europe," will be felt. But it will not hurt us. It need not even break over the sides. There's nothing the matter with the boat that we are in. Straight and strong, well-seamed, well-caulked, well-timbered, with reasonable guidance it will bear us safely and prosperously through.

Sit tight! Don't rock the boat! Keep its head well up against the sea! Don't let it get into the trough of the waves! Let every man realize that at this moment calm confidence and calm thankfulness are the first duty. They are absolutely justified by the favorable situation in which we find ourselves. They are the certain guarantee of a continuance of those conditions.—*Chicago Herald.*

Ash Pan Construction

By Walter R. Hedeman.

Well designed ash pans should provide at least one square foot of air opening under the firebox, for each seven square feet of grate area. That is if the grate surface is 42 square feet, then there should be six square feet of opening in the ash pan. This to obtain good combustion. If a grade of coal high in gas is used, the proportion should be about one to five.

The following gives the method of best obtaining this opening, both on narrow and wide fireboxes, and is the standard practice of one of our largest railroad systems; said practice having been thoroughly tried out and found to give excellent results.

On the narrow firebox type of locomotives where the firebox rests on the frames between the wheels, it is necessary to make the upper portion of the pan, for about 12 inches deep, either of perforated sheets, or of wire netting having about 2½ mesh per inch. The former is preferable and cheaper, the perforated sheets being a commercial article.

At one time, dampers at front and back of the pan were used (same being operated from cab), to increase air openings, but as these were a source of trouble and expense to maintain, and as these openings were continuously desired, the damper rigging has been removed and the size of the openings increased wherever practicable, and covered with wire netting.

A shield or hood is applied at top of opening, to deflect the ashes to main body of pan, and prevent them from falling on netting. Were it not for this hood some hot ashes might find their way through the netting and ignite the ties or station floor. An ash pan with perforated plates is shown on Fig. 1.

To protect the pans and keep them from working out of place, seems to be an unfathomable secret, but some roads permit the injector overflow waste water to go into pan, which not only prolongs the life of the pan, but also wets the ashes down, and prevents the dust from arising and falling over the machinery.

Permitting these overflow pipes to empty in ash pan also prevents splashing of water on station platforms, and at times wetting the passengers, probably preventing lawsuits.

However there are some bad features, such as causing the ashes to freeze up in winter time requiring additional labor to clean pans. It would therefore seem best to permit these pipes in pans at all times in warm or mild climates, and in variable climates to allow them inside in warm weather and outside in cold weather.

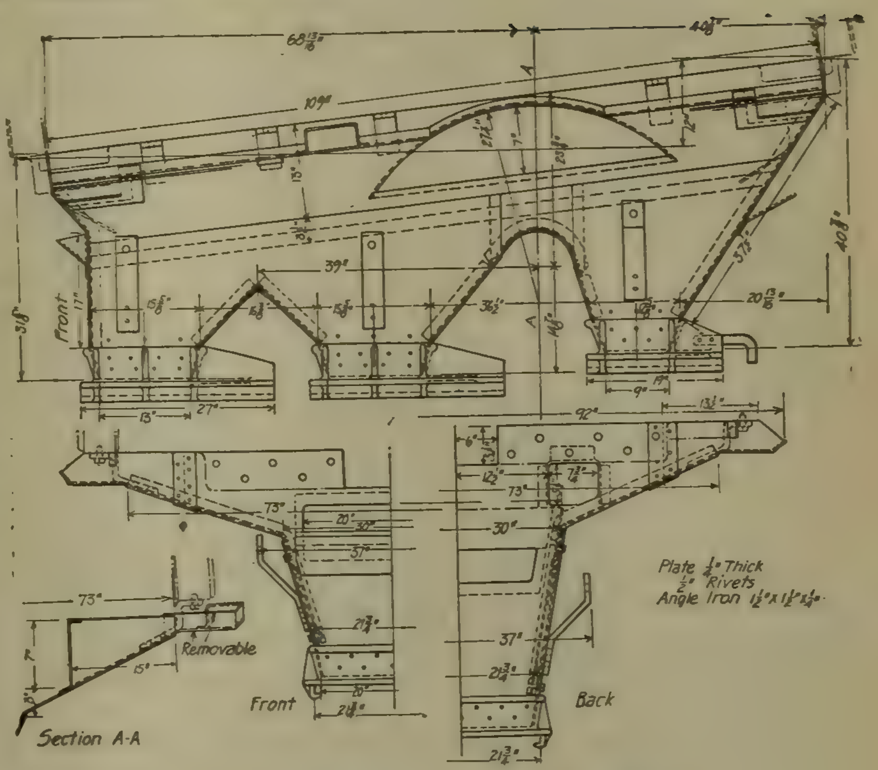


Fig. 2.—Ash Pan with Three Hoppers.

For wide firebox type of locomotives the front and back of pan is the same as on the narrow, except the openings are larger. At the sides it is not necessary to resort to perforated sheets or wire netting; the desired opening is obtained by permitting the pan to be about four inches down from the mud-ring—see Fig. 2.

This opening is generally sufficient, with that obtained through front and back of pan, to give the desired proportion.

This opening is also an additional advantage in that it permits the blowing or the raking of the ashes from the sides or wings of pans.

In the construction of ash pans they should always where possible be sloped at an angle to insure ashes falling to hopper by gravity. Button head bolts should be used and the heads placed on the inside of pan, these being used to give the least resistance possible to the ashes. Removable corners should be arranged for as a convenience in getting at mud-ring corners, where frequent caulking is necessary, and thus prevent taking down the whole pan.

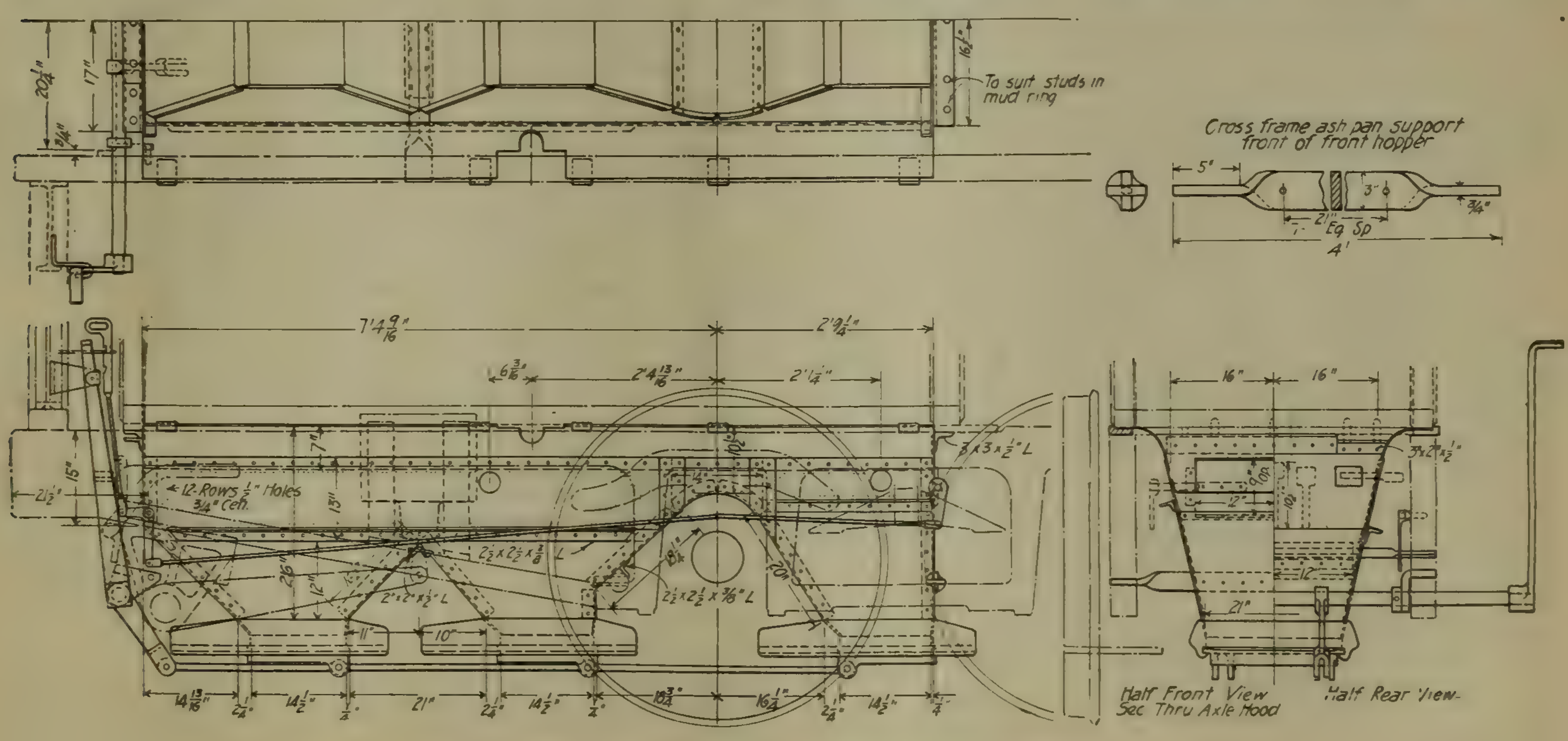


Fig. 1.—General Arrangement of Ash Pan with Hopper Bottom.

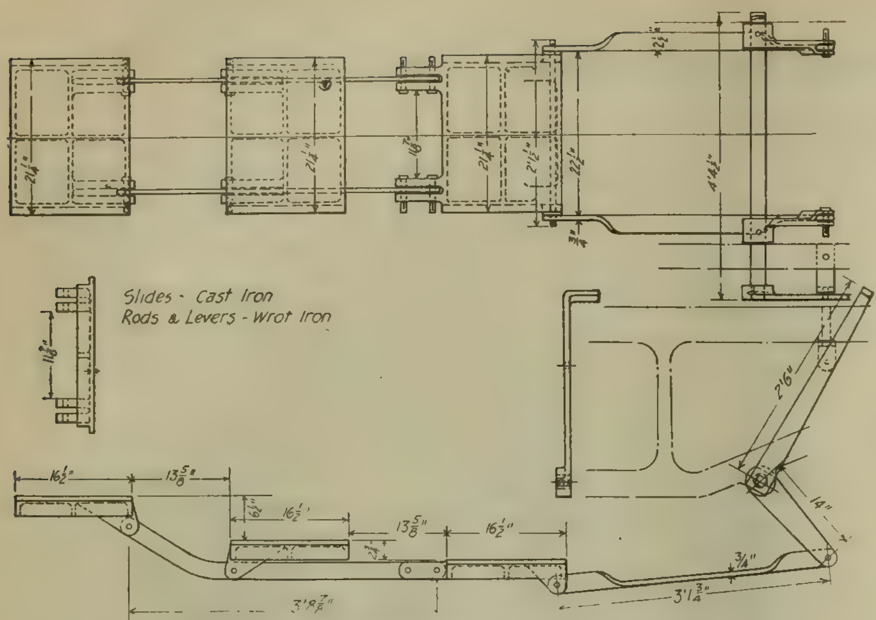


Fig. 3.—Arrangement of Slides for Three-Hopper Pan.

The hoppers should be independent of the pan body, and be bolted onto body. Bottom of hopper should be reinforced with a heavy frame, or slide casting guide; cast steel is preferable for the guide; cast iron is suitable for the slide. No finish is necessary to either the slide or guide.

A good slide or dumping rigging is shown on Fig. 3. Here the ash pan hopper slides are operated by a single lever along side of frame. This permits the quick cleaning of pans at terminals.

A good locking device for this ash pan slide lever is shown in

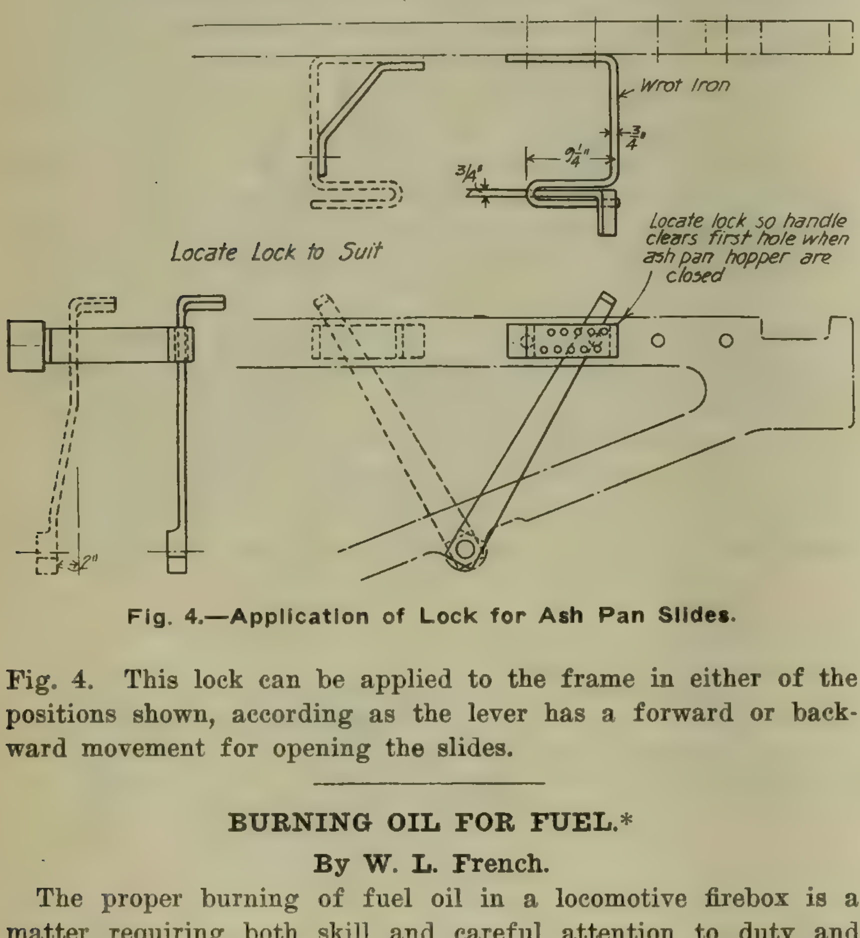


Fig. 4.—Application of Lock for Ash Pan Slides.

Fig. 4. This lock can be applied to the frame in either of the positions shown, according as the lever has a forward or backward movement for opening the slides.

BURNING OIL FOR FUEL.*

By W. L. French.

The proper burning of fuel oil in a locomotive firebox is a matter requiring both skill and careful attention to duty and does not consist of merely turning the oil on at the commencement of a trip and of closing the firing valve when the trip has been completed, as one might suppose from a superficial observation of the matter. True, it is not a question of physical strength and endurance in connection with the proper placing of the fuel as in a coal burning firebox, but it is a question of adjusting the firing valve and its accessories at the proper time, and in the proper manner, to meet the requirements of the service as to full steam pressure in an economical manner.

Variations of pressure or temperature are to be avoided as far as possible, and these may occur more readily in an oil-burning firebox than in one burning coal.

* Extracts from an article in the Locomotive Firemen and Enginemen's Magazine.

So far as the fireman on an oil burner is concerned, it is a case of being on the job all the time. He must be alert for every change in the working of the engine, and if the adjustment of the throttle or reverse lever is altered he must change the firing valve accordingly.

The fire door must be kept closed when firing an oil burner so as to avoid injury to any one in the cab in case of a possible explosion in the firebox. Before firing up, the floor of the firebox of an oil burner should be cleaned of any fallen brick or other foreign substance so that it may be as smooth as possible and not drag the fire, and thus avoid any necessity for forcing the fire, causing black smoke and waste of fuel oil.

If there is steam enough in the boiler to work the blower, atomizer and heater, same may be used to force the draft. No less than 20 pounds pressure will be needed for this purpose.

If there is not sufficient steam, the blower-valve pipe must be connected to the house-supply pipe, and the oil heated to 110 to 115 degrees F., which will just permit of the hand being held against the tank head without burning it. Open the blower valve, then open the atomizer valve and blow the water out of the pipes, after which close the valve.

Light a piece of oily waste and throw it in near the center of the firebox and turn atomizer on strong enough to carry the oil spray to the burning waste. Next open the firing valve lightly at first, gradually increasing the supply after the oil has ignited until steam is being generated without the making of black smoke. The more gradual and evenly this can be done the better it will be for the firebox sheets, the flues and stay bolts. Crowding the temperature and the pressure up rapidly is to be avoided at all times if possible. The roundhouse supply of steam must be used until enough has been generated in the boiler to operate the blower, atomizer and heater.

The amount of heat required for the heater depends very largely on the weather conditions. If the engine is cold and is to be fired up at some outlying point when no roundhouse steam is available, to supply the blower, atomizer and heater, the boiler may be fired up with wood and steam enough generated in this manner to supply the needs of the occasion. The wood ashes must all be removed before starting the oil fire in the firebox for the reason before cited.

Too much oil should not be fed into the firebox at this time as it might result in an explosion. The fire must be watched closely to see that it does not go out, as if unnoticed, the oil might run in the pan on the pit and when ignited cause an explosion that would do much damage to the engine and possible injury to any one on or about her. If the fire does go out, do not try to relight it from the heat of the fire bricks. If you do, there is another chance for an explosion. Light the fire in the usual manner with burning oily waste.

The dampers must be regulated carefully to suit the work being done by the engine; one damper open will furnish plenty of air when firing up or when locomotive is working moderately.

If engine is not working steam the dampers should be closed, as too much cold air admission will cause firebox and flues to leak. Too little air admission when working steam will cause imperfect combustion and steam pressure loss.

The stronger the draft the more tendency there is to draw or put the fire out, and therefore more oil must be fed to keep it burning than when under a moderate draft.

An overfed fire gives off black smoke, and by watching the stack indication this can be avoided. When the throttle valve is shut off the oil supply to the burner must be reduced and the atomizer cut down to a point that will just spray the oil to the fire. The blower must be put on as soon as the engineer indicates that he is about to shut off steam, and it should be kept on enough to keep the fire burning brightly until the throttle is again opened, or if trip is completed until engine is housed and fire is put out.

The working of the atomizer should at all times be graduated to the proper spraying of the feed oil over the firebox for the best results, and to accomplish this the more easily and have

the oil flow freely at all times, it must be heated to a temperature that will prevent its being thick and sluggish and as before stated, a temperature that will permit the hand to be held on the tank head will give this result.

The oil should be heated quickly by turning on the heater strong enough to give a direct flow of a considerable supply of steam, and when the required temperature is secured the heater should be shut off. Opening the heater to a small extent and leaving it on continuously is not a good practice. It takes too long to heat the oil and increases the water condensation in the oil while heating. The temperature of the tank must be watched closely to avoid its falling too low or becoming excessive and causing the oil to boil. The oil should be heated, as far as it can possibly be done, when the engine is standing still.

The drain cock should be opened at frequent intervals so that any water accumulations in the tank will be drawn off, and the danger of the fire going out from this cause will be removed.

An auxiliary super-heater is placed near the burner so as to heat the oil sufficiently to permit it to spray freely when acted on by the atomizer, and result in quick ignition when it reaches the fire.

This super-heater consists of a pipe a foot or so in length and larger than the oil pipe which passes through it and a slight amount of steam in this larger pipe heats the oil as it passes through the oil pipe. Too much steam in this super-heater will cause an intermittent flow of oil to the burner. There is a drain cock to this super-heater to carry off the water. This cock should be open all of the time.

If the flues or flue sheet becomes clogged with soot the engine will not steam. When this occurs frequently it is usually the result of over feeding oil through the firing valve, although it will accumulate when engine is fired properly but not so rapidly as when over fired. It also forms freely when engine is being fired up. Sand is used to cut this accumulation of soot from the flues, and it should be used when engine is working hard so as to strike the flues with a cutting force. Sand should be used when going from roundhouse to train if engine is worked hard enough at any time between these points. The sand is put into the firebox through a funnel inserted in an opening in the fire door that is made for that purpose and the engine should be working hard enough to carry the sand against the flues with considerable force to cut away the soot or gum from them.

The drumming noise sometimes heard in the firebox may be caused by the atomizer being open too much, too great a supply of oil being fed to the burner or too great an air admission through the dampers into the firebox.

Over feeding of fuel oil is more likely to occur when engine is working slowly, and quite often at such times on grades or about yards it is necessary to use the blower to keep up sufficient draft to cause the fire to burn brightly.

The blower should be used whenever steam is shut off but should be worked as lightly as possible; this is true also of the atomizer, dampers and firing valve.

When starting out of a station the injector should be shut off; this is true in the case of either a coal or an oil burning engine.

Slipping is to be avoided on any engine, but more especially so on an oil burner, as were the fire to be drawn out, the fact not noticed and the firing valve closed until it could be relighted in the regular way, a dangerous condition would arise from the oil flooding into the firebox and heating to a point where an explosion might ensue when lighted again in any manner.

If the burner becomes choked up from any foreign substance, it should be blown out by opening the steam valve in pipe to burner and steam supply valve to heater and closing the firing valve.

If the atomizer tube becomes clogged up, open atomizer valve wide, and if this does not remove the obstruction take it out of burner and clean it out. If the oil feed pipe becomes obstructed from any cause, open super-heater valve, open tank valve wide, close firing valve and the obstruction ordinarily will be blown into tank. If not, it will be necessary to disconnect pipes and remove it.

Should the tank heater hose or pipe burst, the oil may be heated after train is stopped in the following manner: Put the fire out, close dampers to protect the flues and firebox, close the firing valve tightly and open tank valve, also open blow back valve and leave it open until oil is again sufficiently heated to proceed with train. This can ordinarily be done without much delay; however, if weather is very cold it may be impossible to get the oil warm enough to proceed at all. The fireman when coming on duty should ascertain if the oil tank has been filled and oil warm. When filling oil tank sufficient room should be allowed for expansion of the oil when heated, and the man-hole cover should be closed and clamped.

The main oil valve should be connected to the engine with a chain, and the safety oil valve by strong cords extending to the front of cab and so placed that either the engineer or fireman can reach them readily.

Care should be taken in the adjustment of the atomizer valve blower, dampers and firing valve. The heater should not be worked so long as to overheat the oil for good firing results. Engines should never be moved when there is no fire in the firebox, as it is injurious to the flues to do this. Great care should be exercised to keep an even temperature in the firebox, and to do this the fire must be watched closer than on a coal burning engine, as both temperature and pressure can be varied more easily on the oil burner than on the coal burner.

New Books

INTERNATIONAL RAILWAY GENERAL FOREMENS ASS'N. Proceedings of the tenth annual convention, Paper, 6x9 inches, 194 pages, illustrated. Published by the secretary William Hall, 1126 West Broadway, Winona, Minn.

The volume contains a report of the convention held at the Hotel Sherman, Chicago on July 14 to 17, 1914, a condensed report of which was given in the August issue of the *Railway Master Mechanic*. Among the subjects discussed are: "Engine House Efficiency," "Valves, Cylinders, Crossheads, Piston and Guides," "Air Brake Repairs" and Autogenous Welding."

Personals

A. J. WIESE, general car foreman of the *Baltimore & Ohio*, has been transferred from Baltimore, Md., to Garrett, Ind.

C. M. WEBSTER has been appointed storekeeper of the *Baltimore & Ohio*, with office at Parkersburg, W. Va. He succeeds D. L. Donaldson, transferred.

R. H. MARQUART succeeds G. F. Snyder as general car foreman of the *Baltimore & Ohio South Western* at Chillicothe, O.

A. L. MOLER succeeds H. P. Roby as traveling engineer of the *Bangor & Aroostock*, with headquarters at Derby, Me.

BENJAMIN S. HINCKLEY, purchasing agent of the *Boston & Maine*, with office at North Station, Boston, Mass., now has charge of the purchase of all material on that road, the office of manager of purchases having been discontinued. The fuel agent also reports to Mr. Hinckley.

W. S. MOSELEY has been appointed mechanical engineer of the *Carolina, Clinchfield & Ohio*, with headquarters at Erwin, Tenn.

E. A. EVERHART succeeds A. L. Ellis as master mechanic of the *Charles City Western*. His office is at Charles City, Ia.

J. H. SCHMIDT has been appointed master mechanic of the *Chicago & Alton* at Slater, Mo., succeeding E. E. Chrysler.

H. C. OTTWAY succeeds E. O. Corey as foreman locomotive repairs of the *Chicago & Alton* at Roodhouse, Ill.

E. H. Hartenstein succeeds W. H. Naylor as road foreman of engines of the *Chicago & Alton* at Bloomington, Ill.

G. A. Secor succeeds Daniel Downing as general storekeeper of the *Chicago & Alton*, with office at Bloomington, Ill. Mr. Secor was formerly storekeeper of the Minneapolis & St. Louis.

W. H. Hauser has been promoted to mechanical engineer of the *Chicago & Eastern Illinois*, with office at Danville, Ill. Mr. Hauser was formerly engineer of tests.

F. E. Wolfe succeeds A. Helmbrecht as locomotive foreman of the *Chicago Great Western* at Hayfield, Minn.

William Schuman has been appointed general foreman of the *Chicago, Indianapolis & Louisville* at Lafayette, Ind. He succeeds George Crumbo, resigned.

J. H. Wood has been appointed supervisor of locomotive operation of Oklahoma and Pan Handle divisions of the *Chicago, Rock Island & Pacific*, with headquarters at El Reno, Okla., vice C. S. Yeaton, transferred.

L. D. Richards has been appointed master mechanic of the Arkansas division of the *Chicago, Rock Island & Pacific*, vice W. F. Moran, transferred. His headquarters are at Little Rock, Ark.

J. C. Rhodes, road foreman of engines of the *Chicago, Rock Island & Pacific*, has been transferred from Valley Jct., Ia., to Des Moines, Ia.

H. H. Jones succeeds J. A. Owen as master mechanic of the *Colorado & Wyoming*, with office at Segundo, Colo.

G. Kehler succeeds T. F. Perkinson as general foreman, motive power department, of the *Delaware, Lackawanna & Western*, with office at Elmira, N. Y.

D. Swineford has been appointed general foreman of the *Detroit, Toledo & Ironton* at Delray, Mich., succeeding B. Ferris.

J. A. Hannigan has been appointed general foreman of the *Detroit, Toledo & Ironton* at Springfield, O., succeeding W. J. Davis.

O. A. Kiethley succeeds A. F. Wilcox as general car foreman of the *J. Dold Refrigerator Line*, with office at Buffalo, N. Y.

A. G. Trumbull, mechanical superintendent of the *Erie*, has been appointed assistant to the general mechanical superintendent. His office is at New York.

E. S. FitzSimmons, mechanical superintendent of the *Erie*, has been transferred from Cleveland, O., to New York, N. Y., where he will have charge of the Erie division.

Charles James has been promoted to mechanical superintendent of the *Erie*, in charge of the Ohio division, succeeding E. S. FitzSimmons. His office is at Cleveland, O.

F. H. Murray, master mechanic of the *Erie*, has been transferred from Port Jervis, N. Y., to Jersey City, N. J., succeeding Charles James.

George Thibaut, general foreman of the *Erie* at Susquehanna, Pa., has been promoted to master mechanic at Port Jervis, N. Y., succeeding F. H. Murray.

T. S. Davey has been appointed shop superintendent of shops of the *Erie* at Buffalo, N. Y. Mr. Davey was formerly master mechanic at Stroudsburg, Pa.

W. H. Snyder succeeds T. S. Davey as master mechanic of the *Erie* at Stroudsburg, Pa. Mr. Snyder was formerly general foreman at this point.

J. E. Cagle succeeds Frank Osterman as master mechanic of the *Fourche River Valley & Indian Territory*, with office at Bigelow, Ark.

J. J. Stahl has been appointed locomotive foreman of the *Great Northern*, with office at New Rockford, N. D.

E. O. Griffin, general fuel and supply agent of the *International & Great Northern*, has been appointed purchasing agent for the receivers, with office at Houston, Tex.

C. J. Bodemer has been appointed master mechanic of the *Louisville & Nashville* at New Decatur, Ala. He succeeds J. J. Sullivan, recently appointed superintendent of machinery of the Nashville, Chattanooga & St. Louis, as noted in the September issue.

T. O. Sechrist succeeds Robert Moran as master mechanic of the *Louisville & Nashville* at Nashville, Tenn.

F. N. Norman succeeds W. H. Davis as master mechanic of the *Marshall & East Texas*, with office at Marshall, Tex.

J. S. Taylor has been appointed master car builder of the *Meridian & Memphis*, succeeding J. A. Jones. His office is at Meridian, Miss.

E. C. Bloom succeeds S. N. Acree as purchasing agent of the *Natchez, Columbia & Mobile*, with office at Norfield, Miss.

E. F. Smith has been appointed acting master mechanic of the *Nevada-California-Oregon*, with office at Reno, Nev.

William R. McMunn has been appointed general car inspector of the *New York Central & Hudson River* with headquarters at Albany, N. Y. He succeeds F. W. Chaffee, deceased.

William V. Wick has been promoted to road foreman of engines of the *Northern Pacific*, with hearquarters at Jamestown, N. D.

J. E. Giles succeeds G. Lund as foreman locomotive repairs of the *Pacific Great Eastern*, with office at Squamish, B. C.

I. O. Rhodes succeeds A. E. Hutchinson as purchasing agent of the *Pacific Railway & Navigation Co.*, with office at San Francisco, Cal.

Frank Aitken succeeds S. A. Chamberlain as master mechanic of the *Pere Marquette* at Grand Rapids, Mich.

F. L. Fox has been appointed general foreman car department of the *Pere Marquette*, with office at Detroit, Mich. He will have charge of all car department matters.

C. Sonburg succeeds J. J. Deitche as general foreman of the *Pere Marquette*, with office at Chicago.

William H. Haskins succeeds U. S. Wilson as general foreman of the *Pere Marquette* at Benton Harbor, Mich.

George Searle has been appointed master mechanic of the *San Pedro, Los Angeles & Salt Lake*, with office at Las Vegas, Nev., succeeding W. A. Rogers.

W. R. Harlan, oil burning inspector of the *Southern Pacific*, has had his headquarters changed from Sparks, Nev., to Sacramento, Cal.

J. Strum succeeds C. R. Petrie as road foreman of engines of the *Southern Pacific*, with office at Sacramento, Cal.

William Schmalzried has been promoted to master car builder of the *Texas & Pacific*, succeeding W. D. Minton, resigned. His headquarters are at Marshall, Tex.

O. E. Linn succeeds B. C. Cooper as road foreman of engines and trainmaster of the *Vandalia* at Decatur, Ill.

OBITUARY.

J. P. McCuen, formerly superintendent of motive power of the Queen & Crescent, passed away at his residence at Cincinnati, O., on October 2. Heart trouble is said to have been the cause of his death, and the end came peacefully with the members of the family

J. P. McCUEN.

at his bedside. Mr. McCuen was born and educated at Uniontown, Pa., and served his apprenticeship in the mechanical department of the Pennsylvania Railroad workshops in his home town. He came west in the early seventies and became affiliated with the Queen & Crescent in the mechanical department. He had been connected with that road for over 30 years until his retirement three years ago as superintendent of motive power. He had been connected with the road in an advisory capacity since that time.

He was a Civil War veteran, having enlisted with the Pennsylvania Volunteers as drummer boy and retired as a private at the close of the war, receiving an honorable discharge. Mr. McCuen was 70 years of age.

Among The Manufacturers

GAS-ELECTRIC CARS, I. C. R. R.

The Illinois Central Railroad has recently contracted with the General Electric Company for four gas-electric motor cars, which will be placed in commission for supplementary service on some of the connecting lines of the company. The railway company has not yet advised where all these cars will be placed in operation, but is canvassing the branch line service on its entire system to ascertain where they may be used to the best advantage. The initial installation will probably be distributed partly on southern and partly on northern branches of the road.

The cars of this company will be what is known as type CRE-70-B-8. The details of construction conform in general to those of the standard gas-electric motor cars manufactured by the General Electric Company. These cars measure 71 ft. 3⅞ in. over bumpers by 10 ft. 6⅜ in. wide over all, weigh approximately 51.5 tons, seat 86 passengers and are each equipped with two GE-205, 600 volt, box frame, oil-lubricated, commutating pole railway motors having a total of 200 hp. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. The generating unit consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct-connected to a 600 volt, commutating pole electric generator, designed to meet the special conditions the service demands.

The interior of the cars is partitioned into five compartments. The cab in front containing the power plant apparatus measures 11 ft. 11 in. long; next is the baggage room, 8 ft. long; then the colored passenger compartment, 9 ft. 10⅞ in. long; the smoking section, 9 ft. 10 in. long; and the passenger compartment, 22 ft. 11⅞ in. long. The track is the standard 4 ft. 8½ in. gauge.

The body of the cars is of all-steel construction, except the seats and interior finish, which is of mahogany. Center vestibules with side entrances run between the passenger and smoking and smoking and colored passenger compartments. A rear platform entrance is also provided. The bearings, and treads and flanges of the wheels conform to MCB standards. The trucks are of the heavy swing bolster type with elliptic bolster and coil equalizer springs.

A WELL LIGHTED RAILROAD SHOP.

Not only does the proper illumination of a shop mean a better and more efficient class of work turned out, but exhaustive tests recently made in a large industrial plant proved conclusively that a workman actually made a gain of several minutes per day in the production of a given piece of work, owing entirely to the better illumination with which he was supplied. These few minutes when multiplied by a large number of workmen amount to a considerable item.

There is shown herewith a night view of an excellently lighted erecting shop of a prominent eastern railroad. As will be noted, the illumination is abundant but entirely without glare or shadows, reaching every part of the shop. The buildings are 528 feet long and 58 feet wide, giving an area of 30,624 square feet in each building.

The illumination for these buildings is furnished by type Z Cooper Hewitt quartz lamp operating in a 220-volt direct current circuit. This lamp is a modification of the well-known Cooper Hewitt lamp based on the same fundamental principles, but possessing some essential differences. The lamp uses the mercury vapor, and a short tube of pure fused quartz instead of the long tube of lead glass used in the older types.

Ten lamps are installed in the boiler shop placed at regular intervals of 52 feet down the middle of the building, each lamp lighting an average of 3,062 feet.

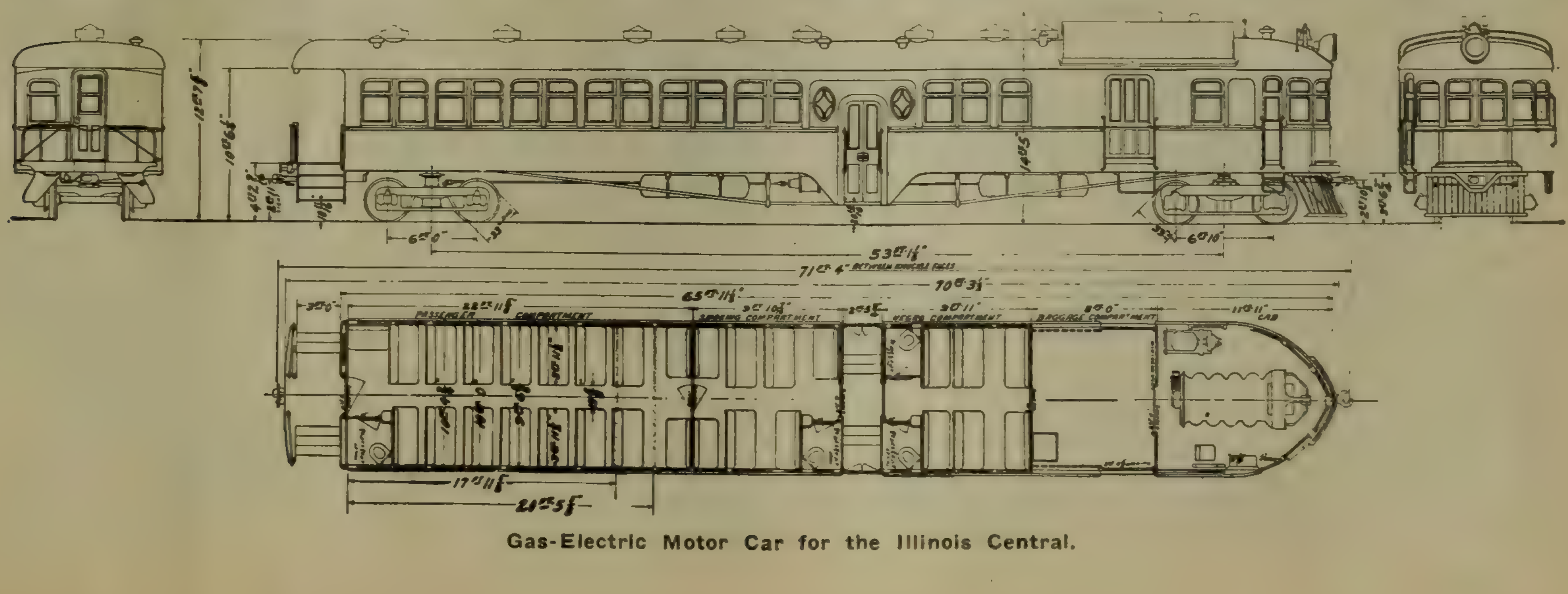
In the erecting shop there are twelve lamps regularly spaced down the middle of the building at intervals of 44 feet, giving an average space lighted by each lamp of 2,552 feet. All the lamps are hung at a height of 50 feet above the floor.

The lamps are rated at 2,400 candlepower with an energy consumption of 725 watts, or a total for the installation of approximately 16 kilowatts.

The light afforded by these lamps is entirely sufficient for all purposes, even the locomotive pit being well illuminated. The only other form of artificial light required is a portable hand lamp needed by the workman when he goes inside the boiler.

The total lumens per lamp from these units is 14,603, with a total available in a zone of 0 to 60 degrees of 10,800 lumens per lamp which, with a wattage of 725, gives a value of 20.2 total lumens per watt, and 14.9 available lumens per watt.

The efficiency of the system as installed is made evident from the low wattage consumption obtained per square foot, these being



Gas-Electric Motor Car for the Illinois Central.

A Well Lighted Erecting Shop.

.28 for the erecting shop and .24 for the boiler shop, the former being said to be the best lighted erecting shop in the country.

The average candle feet obtained are 4.24 for the erecting shop and 3.53 for the boiler shop.

The employees who are working under the light are universally pleased with it and the results they are able to obtain. It is interesting to note, however, that when a trial installation of four lamps was first made, there was a certain antipathy to the light on the part of the men employed, because of the difference in color value, but this speedily disappeared after they gave it a thorough trial. This trial resulted in the adoption of the complete installation of these units.

The lamps have been installed at various times but the entire installation averages practically 16 months and the maintenance charges for the period totals $134.54, or $4.58 per lamp per year.

New Literature

The Independent Pneumatic Tool Co., Chicago, has issued circular "V" descriptive of "Thor" roller bearing piston air drills, pneumatic hammers, turbine drills, staybolt drivers, air hose, couplings, etc.

* * *

"Oil and Gas Burning Appliances," is the title of Bulletin No. 5 of the Quigley Furnace & Foundry Co., Springfield, Mass. This company some time ago took over the patents of the Rockwell Furnace Co. The bulletin referred to describes a complete line of burners, pumps, blowers, hose, gauges and tanks.

* * *

Recent bulletin of the National Tube Co., Pittsburgh, Pa., contains a full description of several special tests made on "Kewanee" unions.

* * *

The Smooth-On Co., Jersey City, N. J., has issued instruction book No. 15, which is the largest and most complete book they have ever put out. It tells about the eight different Smooth-On iron cements, Smooth-On iron concrete paint and Smooth-On coated corrugated iron gaskets.

* * *

Record No. 79, of the Baldwin Locomotive Works is devoted to descriptions and illustrations of Pacific type locomotives recently built for seventeen different roads.

* * *

Tate, Jones & Co. Inc., of Pittsburgh, have issued a very complete and artistic catalogue of appliances for burning fuel oil. Part one gives results of some comparative tests of coal and oil, and gives descriptions of a variety of burners for different purposes. Part two is devoted to pumping systems for oil supply systems.

The Selling Side

ELLIS F. MUTHER, eastern sales manager of the Gisholt Machine Co., Madison, Wis., with headquarters in New York, has been appointed general sales manager of the company, with office at Madison. J. L. Osgood has been appointed exclusive agent in Buffalo and Rochester, N. Y. R. D. Heflin, formerly representative of the company in New England, has been placed in charge of the New York office, and will henceforth attend to the interests of Gisholt customers and users in the entire eastern territory.

F. J. O'BRIEN has been appointed general sales agent of the Globe Seamless Steel Tubes Co., Chicago.

CHARLES W. ALLEN, formerly vice-president and sales manager of the Reading Specialty Co., and manager of the railway department of the Reading Bayonne Steel Casting Co., has become associated with the sales department of the Q. & C. Co. of New York and Chicago.

The general sales offices of the Cambria Steel Co., now located at Johnstown, Pa., are to be removed within a few weeks to Philadelphia. It is expected that not later than November 1 the entire sales offices will be located on the seventeenth floor of the Morris building in Philadelphia.

A petition in bankruptcy was filed against the Crawford Locomotive & Car Co., Streator, Ill., on September 26. The Central Trust Co. has been appointed receiver.

JOHN L. TERRY, general manager of the Denver, Laramie & Northwestern, has resigned to become connected with the Denver office of the Rail Joint Co.

R. L. BROWN has been elected a director and vice-president of the M. C. B. Co.

F. J. O'BRIEN has been appointed general sales agent of the Globe Seamless Steel Tubes Co., with office at Chicago.

OLIVER K. BROOKS, secretary and treasurer of The National Malleable Castings Co., died at his home, Cleveland, Ohio, on September 14.

The Monarch Steel Castings Co. of Detroit, Mich., has opened an exhibit in the office of H. F. Wardwell, their Chicago representative, Railway Exchange building, Chicago, of Lion and Monarch couplers, Lion coupler pockets for locomotives, and Lion cast steel yokes.

S. L. SCHOONMAKER has been elected chairman of the board of the American Locomotive Co., succeeding Pliny Fisk, resigned. Mr. Schoonmaker is a director of the General Electric Co. and the American Telephone & Telegraph Co.

W. E. MARVEL has been elected vice-president of the Positive Rail Anchor Co. Mr. Marvel has sold his interests in the M-C-B Co. to R. L. Brown.

THE RAYMOND CONCRETE PILE CO., New York, has been awarded a contract for the design and construction of concrete ore, coke and limestone bins, and ore and yard trestles, by the Pennsylvania Steel Co., Steelton, Pa.

THE GUN-CRETE CO., of Chicago, has purchased the Cement-Gun Construction Co., and have also taken over the construction department of the General Cement-Gun Co. The combined business will be conducted under the firm name of Cement-Gun Construction Co., with offices at 914 South Michigan avenue, Chicago.

H. O. FETTINGER, formerly with the Clement Restein Co., has entered the railroad department of the Ashton Valve Co., with office at New York.

JAY G. COUTANT, formerly engineer of the plant of the Lima Locomotive Corporation, Lima, Ohio, has become associated with the Railway Materials Company, Chicago, Ill.

THE NEW PROCESS GEAR CORPORATION, Syracuse, N. Y., is building an addition to its plant. The plant was doubled in capacity less than two years ago.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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CHAS. S. MYERS, Vice-Pres. L. F. WILSON, V. P. & Editorial Director
C. C. ZIMMERMAN, Bus. Mgr. OWEN W. MIDDLETON, Editor
DALTON RISLEY, West. Mgr. W. A. D. SHORT, Editor

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York.
Telephone, Cortlandt 5765
Address all editorial and business communications to the Company, at Chicago.

A Monthly Railway Journal

Devoted to the interests of railway motive power, car equipment, shops, machinery and supplies.
Communications on any topic suitable to our columns are solicited.
Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to The Railway List Company.
Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.
This Publication has a larger circulation than any other among mechanical department officers. Of this issue 4,500 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIX Chicago, November, 1914 No. 11

CONTENTS.

Boiler Maintenance

Engine failures are of more frequent occurrence during the winter season now upon us and an article on another page dealing with the maintenance and care of locomotive boilers treats this timely subject in an interesting way. The writer states that co-operation between the shop, roundhouse and enginemen is essential for the successful maintenance of the locomotive boiler and says "the prevention of engine failures due to leaky flues does not rest entirely with the roundhouse boilermakers, regardless of the fact that they are compelled to assume the responsibility in most cases." That this latter statement is true every railway mechanical man well knows. The roundhouse foreman has always had more than his share of trouble, for if anything goes wrong it is easy to put it on the roundhouse.

Co-operation is necessary in order to avoid leaky flues and engine failures, but in order to secure this co-operation, it is necessary that everyone who has anything to do with the boiler, should appreciate the very essential fact that sudden and large changes in temperature in a boiler are certain to result in unequal strains which will cause trouble. Probably the worst example of this is the use of the injector and the putting of a large amount of water into the boiler after the fire has been drawn. The relation between the use of the injector and the state of fire needs to be impressed more strongly on engineers in order to effect a decrease in the number of leaky flues.

The proper washing of the boiler at the roundhouse is also an important factor in boiler maintenance and the writer of the article referred to, gives a number of very good rules for boiler-washing. There may be some who differ as to the method of procedure, but the essential that is emphasized is thoroughness. Increased attention to the use of the injector and keeping the boiler clean are the two most important points in boiler maintenance.

Smoke Prevention

The subject of smoke prevention is a very familiar one, both to railway men and to the general public, especially in large cities. Most of the larger cities now have ordinances governing the emission of smoke and in their enforcement the railways are always made the target, and unfairly so. The emission of smoke by factories, boats, etc., has not been watched closely in the past by city authorities, who have found it more popular to inflict fines on railways. But good has come even from this condition. At a recent railway convention a member said that he wished that the smoke ordinances of a certain city covered his entire division; that he could tell when a crew left the city limits by the appearance of the stack.

Smoke prevention is simply a question of perfect combustion. Black smoke escaping at the stack simply means that energy (and therefore money) is being wasted. Traveling engineers, and those interested in locomotive operation, are studying the scientific explanation of obtaining energy from matter. The burning of coal is a chemical action. It requires air, it requires the air brought into very close contact with the fuel and it requires a high enough temperature to be maintained so that all the fuel shall undergo the proper chemical change. The traveling engineer does not need to be a chemist, but he does need to know some chemistry to understand how he can get every ounce

of energy out of his coal. The locomotive firebox is a laboratory, not just a hole to throw coal into, and laboratories depend for results upon men.

There are devices for application to the locomotive which do assist in securing perfect combustion and therefore preventing smoke, but the question of smoke prevention is essentially a matter of education and discipline. An engine can be fired without emitting clouds of black smoke and it is up to the men in the cab to see that it is done. The crew which kept the smoke down within the city limits could have done it over the rest of the division, if they knew they would be fined for not doing so.

Black smoke is an evidence of waste and we Americans are just waking up to the fact that we have been and still are wasting energy and material in many ways. Attention to details results in high efficiency. The education of traveling engineers and engine men as to what actually goes on in the firebox is the only sure way of smoke prevention.

Publicity

Some railway men give as a reason for not contributing to the technical press, that they are not seeking publicity and do not care to have their name in print. There are probably not very many who hold this view and certainly they have a right to their opinion. But is publicity detrimental and unnecessary? As time passes, there is closer coöperation between all lines of activity on American railways, as instanced by the many railway associations and clubs, which constantly are taking up the important questions in their respective fields. The Master Car Builders and Master Mechanics' Associations could not have accomplished a great deal if each member had not contributed his experience and his ideas to its proceedings.

Ideas are only of value when they are put into effect, so that someone else learns of them. The general foreman who has worked out a method of cutting welding costs in half certainly would not deny that he did it. If the subject came up at the next meeting of his association he would owe it to his railway, to his fellow workers and to himself to tell them of what he had done along that line. The man who gets up and talks at these meetings is regarded as a man who is interested in his work and his association. Possibly it is a co-incidence, but quite often the men most interested in giving others the benefit of their experiences are the ones who we hear of as being promoted from time to time.

The technical journal is in a less specialized way keeping up the interchange of ideas and conveying new ones to its readers throughout the year. Is the case materially different whether a man's ideas appear in type or whether he tells his fellows his views in person (which later appear in the proceedings). In giving his methods in the well established technical journal, he is doing other railway men more good for he reaches more of them. The man who has ideas which have proved of value, should feel it a duty to give them publicity.

A man may possess ability of the highest order but if no one knows of it, of what value is his ability to himself or others? The man who rushes here and there with half-developed theories will soon be checked, but the man who knows that his ideas have been proved sound should not be ashamed to express them. Advancement will come to him because others know of his worth.

Publicity for sound practical facts is necessary in these days. It is always helpful to every one concerned.

Shop Motors

At the recent convention of the Association of Railway Electrical Engineers the committee on data and information presented some rather interesting figures on electrical equipment of shops collected from forty-three of the leading roads and representing 415 shops. With regard to the generators, these tables show that the alternating current machines are more largely used than the direct current machines, the capacity in kilo-watts of the former being about twice that of the latter. It is rather surprising to note that 42 per cent of the shops purchase power, while 58 per cent generate their own power. However, the 42 per cent only represents 30 per cent of the power, leaving 70 per cent of the total power load which is generated by the railways. These figures are accounted for by the fact that in many cases it is more profitable to purchase power at roundhouses and back shops than it is to install power generators. In total shop motor horsepower the Pennsylvania Lines East leads all other roads, having over twice that of any other road.

The committee deduced a factor for the shop motor horsepower per locomotive in service for each road and the average for all was found to be 5.37. However, this is scarcely a fair basis for comparison, as it contains no reference to the work done or the number of locomotives put through the shop. Also it was obvious that some roads had listed other motors aside from those in shop service and that accurate classifications had not always been made in the data furnished. However, the data is interesting as bearing on the growth of electrical operation in shops. It was recommended, and is to be hoped that next year's committee will obtain more detailed information as to locomotive shop motors, and especially with reference to the shop output. A study of motor sizes, types, manner of grouping, costs, and shop output for say 10 of the largest and most up-to-date locomotive shops in the country would undoubtedly bring out some interesting results. That such investigations by the Association of Railway Electrical Engineers would be well worth while is certain.

Wiring Engines

It is surprising that more has not been done in standardizing electric wiring and equipment on locomotives, in view of the fact that the electric headlight is in such general use at present. As far as can be ascertained there is little uniformity in methods at present. One road at least, the Canadian Northern, has standardized its entire headlight equipment, as described on page 427 of the September issue. Instead of running the wiring through the hand rail as is frequently done, this road uses an armored insulating conduit running in a groove in the lagging, and also uses armored conduits in the cab. The cab lights have also been carefully worked out and combine an oil auxiliary in connection with the electric bulb. Many roads favor the open wiring in the cab as it makes it easier for the man who has to do any repairing. It is questionable, however, even with the lower cost, whether this system would prove as satisfactory as the conduit. Here is a comparatively new problem upon which some work could be profitably done.

Twenty Years Ago This Month

(*From the Files.*)

Complaint is being made that the hall at the Great Northern Hotel in which the Western Railway Club is meeting is entirely too small. The membership and attendance has increased so fast that the club has outgrown its meeting room. At the October meeting, A. M. Waitt, general master car builder of the Lake Shore & Michigan Southern, presented a paper on "The M. C. B. coupler in 1894." Mr. Waitt presented considerable data obtained from over forty roads and stated that "throughout nearly all the tables attached will be noted an altogether too prominent class of breakage, namely, in the shank."

The technical press comments on the frequency of train robberies and suggests that the Federal government is lax in not protecting railway trains. A large number of robberies have taken place.

An engineers' air brake valve has been patented by J. F. Voorhees, of Philadelphia. It is designed so as to admit air under pressure into the train pipe when the pressure in this pipe is less than desired, so as to maintain in the train pipe whatever pressure is necessary for operating the brake mechanism or to relieve the pressure to any desired extent.

The Lehigh Valley has placed in service a lunch car, provided with a counter such as used in lunch rooms.

The Brooks Locomotive Works of Dunkirk, N. Y., has just filled a large order of locomotives for the Brazil Central Railway.

A cow wearing a bell was run over and killed on a railway near London, England, and the owner sought to recover damages from the railway company. On the trial of the case it was proven that the engineer blew the whistle loudly, trying to frighten the cow away from the track. The farmer's lawyer also proved that the cow was equally attentive to business as the engineer, in ringing her bell and exerting herself to scare the engine off the track. The jury gave a verdict for the cow.

A series of tests of M. C. B. couplers has been conducted at Melrose Park, Chicago, under the auspices of the Chicago Tire & Spring Co. The tests were witnessed by a large number of railway men.

The master mechanics and superintendents of motive power of roads running into St. Louis held a meeting to discuss the question of smoke abatement. H. M. Smith, of the Terminal Railway, presided. Steam jets and other appliances were discussed but it was decided that the best means of preventing smoke was careful handling of the locomotive.

The Boston & Albany has received a couple of eight wheel locomotives from the Schenectady Locomotive Works, for fast passenger service between Springfield, Mass., and Albany, N. Y. The weight on the drivers is 74,000 pounds and the heating surface 1,844.7 square feet, an unusual area for engines of this weight. The main pin has the peculiarity of being hollow. The total wheel base of engine and tender is 55 feet 7½ inches.

An automatic abutment for metallic rod packing has been patented by F. J. Cole, mechanical engineer of the Baltimore & Ohio. It limits the movement of the springs and prevents them from flying back or sticking.

The erection of the new shops of the Louisville, New Albany & Chicago at Lafayette, Ind., is progressing rapidly.

It is reported that the Big Four will build new shops at Indianapolis next spring. The plans were made a year ago.

The daily newspapers have circulated a report that the Pennsylvania is building a locomotive at Altoona, equipped with ball bearings. Theodore Ely denies it and brands the story as a fake.

Considerable space is given in railway papers to the air-brake decisions, covering the controversy between the Westinghouse and the New York companies.

James Meehan, for many years superintendent of machinery of the Queen & Crescent, has been appointed superintendent of motive power of the South Carolina & Georgia.

M. E. Wallace, chief draftsman of the Chicago, Burlington & Quincy at Aurora, Ill., has resigned to accept a similar position with the Westinghouse Air Brake Co. F. H. Clark succeeds Mr. Wallace as chief draftsman of the Chicago, Burlington & Quincy.

The new works of the Westinghouse Electric & Mfg. Co. at Brinton, Pa., are being fitted with machinery and will be opened shortly.

The Buffalo, N. Y., Express says: "One of the livest places in East Buffalo nowadays is the north yard of the New York Central, where the old cars are broken up. The cars are placed on the side tracks and the Poles in the neighborhood are invited to help themselves to the wood, with the provision that none of the iron be taken. Yesterday nearly 100 cars were placed on the tracks and by evening there was left but a mass of trucks and iron. People of all sizes, sex and conditions were busy all day with saws, hammers and axes in laying away firewood for the winter."

In commenting on a freight wreck caused by a falling brake beam a writer says "it is more dangerous to ride on cars equipped with brake beams than to rob a bank."

B. M. Galbraith, general master mechanic of the St. Louis South-Western, being hard pressed for additional locomotives, recalled that in years past a practically new locomotive fell into the Red river at Garland City, Ark., and going into quick sand was given up for lost. He got together a force of six men and in about sixty days, recovered the locomotive. It was almost as good as new, having been well preserved.

ATLANTIC CITY CONVENTIONS.

The 1915 conventions of the American Railway Master Mechanics' Association and the Master Car Builders' Association will be held at Atlantic City, N. J., on June 9 to 16, inclusive. This was decided upon at a meeting of the executive committees of these two associations and the executive committee of the Railway Supply Manufacturers' Association, held at the Hotel Biltmore, New York, on October 22. The headquarters at Atlantic City next year will be at the Marlborough-Blenheim hotel as before and it is expected that the convention hall on the pier will be somewhat enlarged. Several ballots were taken in deciding upon the place of meeting for 1915, as Chicago and San Francisco were also strongly favored.

A NOVEL SUGGESTION FOR SUPERVISION.

In an article in the *Chicago Tribune* on October 27, E. P. Ripley, president of the Atchison, Topeka & Santa Fe, advocated a system of government supervision of railroads in which the roads would be grouped similar to the regional reserve banks, with one or more representatives of the government on each board of directors, and backed by a Federal guarantee.

"The present system of regulation is failing," said Mr. Ripley. "Some method of economy must be worked out. Every night five magnificent trains leave Chicago at practically the same time for Kansas City. Each carries every modern device of comfort. Possibly one of these trains—two certainly—could care for the business. Six trains leave Chicago for Omaha nightly and five for St. Paul. Two trains could do the business much cheaper and much better.

"Under the present system of regulation the greatest injustices have been done the stable and efficiently managed roads. Certain irregularities—dishonesties—in certain corporations have been seized upon for a justification for putting a strait-jacket on the entire transportation of the country. To me it seems perfectly clear that this system, under which private individuals are expected to furnish the cash, while a group of lawyers at Washington provide a management of their own theories, cannot possibly continue. Something certainly will happen, and that very soon. Is there no relief save in government ownership, with its waste, inefficiency, and disastrous politics?

"Suppose all the unnecessary train service, now forced by railroad competition, all ticket and freight solicitors and their offices, and all the unnecessary duplications, were eliminated? Think

of the saving. Suppose the railroads were allowed to co-operate? Suppose railway groups were established, somewhat after the manner of the regional reserve banks? Each group of railroads could be governed by a board of directors in which the government could be fully represented.

"The government should say to each of the lines serving certain territory, 'We will guarantee that your net earnings for the next five years shall not be less than the average for the last five and you also shall be guaranteed 6 per cent on any additions and betterments which, with our consent, may be made on the property. In return we demand one or more seats on your board and the power of absolute veto upon any act or proposed act which we may consider disastrous to the community or otherwise improper.' Would not the net earnings of all the railroads be at once improved and the guaranty of the government at once rendered safe? Immediate restoration of confidence would result. This system would give us all the admitted benefits of common control—all of the economies incident to common ownership and, at the same time, protect the rights of the public. It would do away with the enormous wastes of the competitive system and permit business to follow the line of least resistance.

"I do not belittle the difficulty of such an arrangement and I realize that everything would depend upon the men selected for such control. I offer this scheme as my personal solution of the problem. I do not know that my board of directors would follow me in my suggestions. There is one thing that to my mind is certain, however, and that is that we must make a choice soon, very soon. We must choose between the starving of the railroads into a semi-paralysis, absolute government ownership, the turning of the railroads loose to shift for themselves without restrain of any kind or the adoption of the system I have proposed."

CORRESPONDENCE.

Editor *Railway Master Mechanic:*

In regard to autogenous welding, will say that we have used the Thermit method for welding frames, but we are about ready to install the oxy-acetylene method, with which we expect to weld frames and do any other kind of welding that we find necessary. We welded a flue sheet in one of our engines with the oxy-acetylene method at a cost of about $68.00, which otherwise the flue sheet would have had to be removed and would have cost at least $300.00, besides the time which the engine would be out of service. In the case where we welded the flue sheet the engine was only out of service three days. We have not had any experience with the electric welding.

N. B. WHITSEL, G. Fmn. Loco. Dept., C. & W. I. R. R.

Editor *Railway Master Mechanic—*

At this time when every economy is being carried into effect by the railways, it would be well for locomotive shop men to take notice of the possibilities of reducing the cost of shop air hose. A few weeks' observation of this one item of expense alone has enabled one locomotive shop to reduce the air hose expense much more than would be believed, if the amount was here stated.

In the first place it was found that wire bound or armoured hose was not at all efficient or economical. The air motors were not performing to any where near their capacity owing to being throttled on account of the hose having had material thrown upon it or perhaps run over by shop trucks, which crushed it to such an extent as to almost close the air passage. The wire did not allow the hose to open up to its original conformation. In a shop maintaining an air pressure of 100 pounds I have found that half-inch hose need not be more than three-ply thick, and that three-quarter-inch hose is quite efficient and strong when five-ply thick. This gives a hose that is not too heavy for the operator to lift and carry from one pit to another. That most of the damage to hose is caused by carelessly dragging it about the shop is evident after but slight investigation.

The hose that has been found to be the most durable and satisfactory is called "moulded" hose and the data for the durability claim is taken from the repair man's record book. As there is but one man doing all hose work, this is quite easily kept track of. There is also a great difference in the price of moulded hose and armoured hose, in some cases as much as 30 cents per foot.

I have been in railroad shops where the armoured hose has been supplied and have seen the men remove the wire and throw it away. Of course it may be said that hose should not have material thrown upon it or get run over by trucks, etc., but I have yet to see hose used in a locomotive boiler or erecting shop which does not occasionally receive such treatment.

OBSERVER.

THE TROUBLE MAN?

A. E. M.

Away back in 1905 George A. Post delivered an address before the Railway Club of Pittsburgh, wherein he said or proposed to give the railway supply man a title, "Commercial Engineer," I think this is what he wanted to call them.

Quite a few railway supply concerns have on the road what they see fit to call their "trouble men." They are usually sent out where there is trouble, or at least it would look that way to an outsider, but the name "trouble man" is not a good or proper definition for such work as the writer knows they perform. They perform services very often; in fact, most of the time, where there is no trouble at all. They are called upon to make tests of all kinds to demonstrate in a practical way the practicability of the devices handled by the concern they represent. In the course of their work they are called on to ride locomotives at all hours of the day or night. They may be found working in the roundhouse or back-shop and are always ready to show someone who may not be familiar with their devices just how it should be applied or used. They can be found one day associating and working with mechanics in a roundhouse or shop, faces and hands covered with grease, and they next day they are equally as well at home in the general manager's office, where they may be found explaining the fine points of their device to the general manager in order that when the salesman or "Commercial Engineer" comes round to take his order he may know where he is at. Generally speaking, these same "trouble men" are of the highest caliber in more ways than one. Generally they have been through the school of hard, practical experience. There will be found among them ex-locomotive engineers, traveling engineers, mechanical engineers, master mechanics, general foremen; in fact, most "trouble men" are graduates of some such position, having been formerly actively identified with some railroad company. This all makes their services very valuable to railway supply concerns in the line above mentioned, and if there are any more who know what "bull-dozers," "lost motion," "superheaters" and all that are, why, it's this same "trouble man," and the writer thinks it's about time he had his official title changed to something more dignified and that would explain in a word or two just what he was. I think "Service Engineer" would about fill the bill. If not, why not?

THE AMERICAN ELECTRIC RAILWAY Association held its annual convention at Atlantic City, N. J., on October 12 to 16. The papers and reports were, of course, of primary interest to electric railway men, but contained considerable of interest to steam railway men also.

THE AMERICAN ASSOCIATION of Railway Surgeons held its eleventh annual convention at the Hotel Sherman, Chicago, on October 14 to 16. Among the papers presented was one on "Lighting as a preventive for accidents in car shops," by G. R. Cravath. Officers elected for the coming year are: President, Dr. G. F. Beasley; vice-president, Dr. G. P. Kaster; secretary-treasurer, L. G. Mitchell, Chicago.

Oelwein Tool, C. G. W. R. R.

By G. W. Nutt, Tool Room Foreman.

The tool room at the Oelwein shops of the Chicago Great Western R. R. is one of the many busy little tool rooms which are characteristic of our American railroads. Oelwein, Ia., is a live little city of about 7,000 inhabitants, and is the hub of the Chicago Great Western system, which has in operation about 1,500 miles of road, radiating in four directions from this point. The shops, therefore, being centrally located, are called upon to furnish and keep up practically all stock repairs and tools for the entire system.

The dimensions of the tool room are 38'x64'. The layout of the room is shown in Fig. 1. The equipment is as follows:

One 21"x10' Le Blond lathe.
One 24"x10' Lodge & Shipley lathe.
One 14"x6' Lodge & Shipley lathe.
One No. 3 Brainard universal milling machine.
One No. 3 Hendey-Norton milling machine.

Fig. 2—Oelwein Tool Room, Chicago Great Western R. R.

One 12"x36" bath grinder.
One Q. & C. No. 4 shop saw.
One Marvel No. 2 draw-cut saw.
One 12" Yankee drill grinder.
One Brown & Sharpe universal grinder.
One 12" drill press.
One No. 5 safety grinder, motor driven.

A view of one end of the tool room is shown in Fig. 2. This shows the tool dresser with equipment, consisting of a forge, 20"x20"x36" coke furnace with fan blast, coal and coke bin, 75-pound American Engineering Co. air hammer, and an iron water tank 20" wide, 40" long and 36" deep, with an oil tank 12" in diameter and 30" deep, set in one end of it. A compressed air line is connected at the bottom of this tank to keep the oil in circulation when hardening long tools. The illustration also shows the necessary steel cupboards, tool racks, etc. All machine tools are dressed here and then ground on a safety grinder to their proper shape.

When a tool is worn out or needs dressing it is brought to the blacksmith's window and exchanged for a finished one. This also applies to hand chisels, etc., the necessary cupboards being provided for same. For hardening high speed tools the air is passed into and taken out of the top of a small reservoir to insure the air being as dry as possible.

The inserted blade taper reamer, shown in Fig. 3, is for reaming out nigger heads and steam pipe joints. We have done away with the ball joint, which is a very radical departure in steam pipe work. Our trouble with leaky joints became more serious when superheaters were applied, and G. M. Crownover, superintendent of motive power, designed taper joints and rings, giving them a taper of 12 degrees and practically all our locomotives are now equipped with these joints. It is two years now since the first application was made and the results have been remarkable, for all leaky joints have been eliminated. It was up to the tool room to furnish reamers to ream out the joints and after trying to get

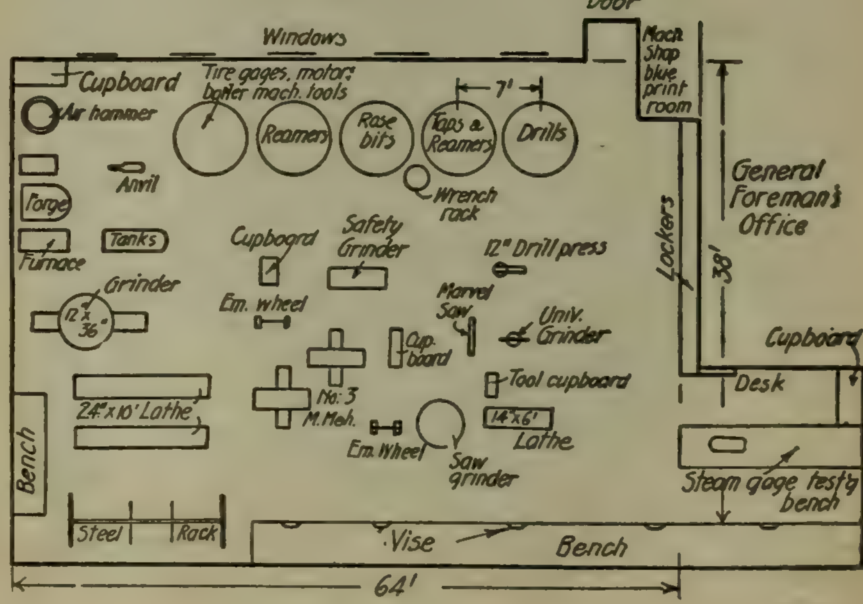


Fig. 1—Tool Room Layout.

Fig. 3—Inserted Blade Taper Reamers, Etc.

under the scale and rough out with different kinds of cutters, I solved the problem by making a cutter of machinery steel, with inserted blades of high-speed steel. I also made some of carbon steel, dipped them in water and did not draw the temper. These were used for finishing, but I found out I could nearly always get a good joint the first time with the inserted blade reamer. The steam pipes are reamed on a radial drill press and the steam pipe holes in the cylinder with a motor driven angle reducing attachment.

At one end of the tool room, not shown in the photographic illustration, is a steam and air gauge repair bench with one hydraulic tester and one weight tester.

Fig. 4 shows the ball-bearing racks in use at our tool room. The one on the left is for holding milling cutters. The stand is 3′-6″ high overall and has four shelves or ⅛″ iron disks, with ⅜″ iron pins flattened out at one end and riveted around the various disks. The diameters of these disks vary from 18″ at the top to 26″ at the bottom. The rack shown in the illustration has 280 cutters on it and room for more. It sets on the bench, in a location to be handy to the machine. The rack on the right speaks for itself—the blacksmith doesn't have to go far for his chisel or flatter. The jig in the center of the illustration was designed by E. A. Barnes, assistant machine foreman, and is used for drilling holes in eccentric straps. The two halves are put together in the rough and the holes drilled down through both straps, maintaining the standard centers. The jig is so arranged that the holes

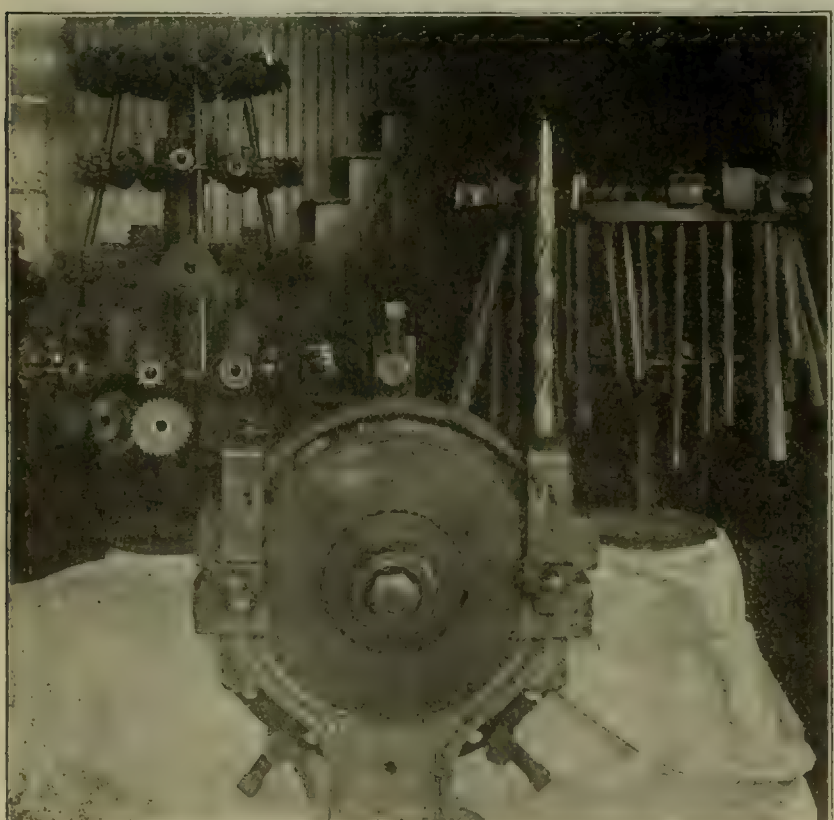


Fig. 4—Ball Bearing Racks and Eccentric Strap Jig.

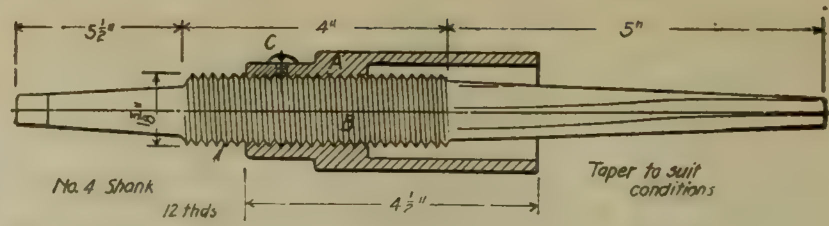


Fig. 5—Reamer for Crown Bolt Holes, Etc.

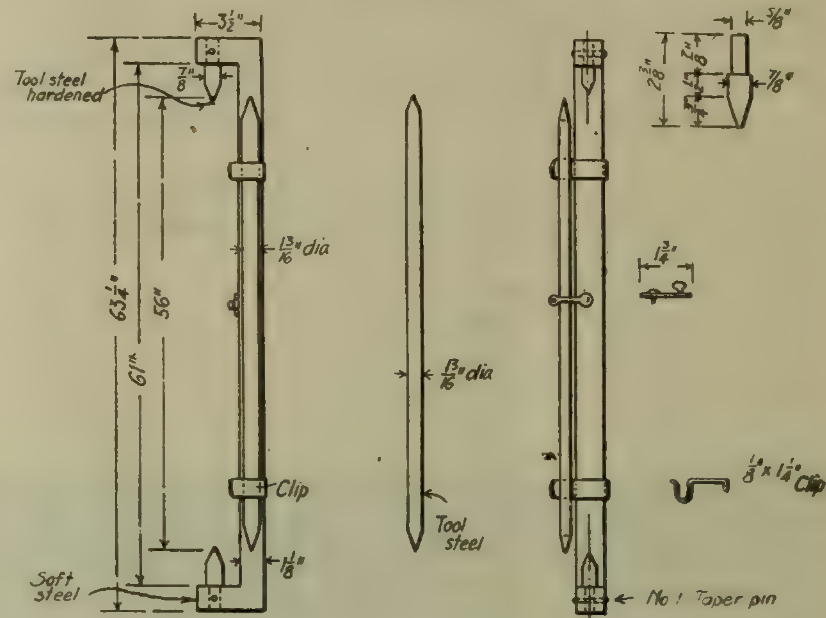


Fig. 6—Gauge for Calipering Wheel Centers.

for the cellars on the bottom of the strap are also drilled and the holes for the oil cups are drilled and tapped on the machine with one setting. The eccentric strap is fastened in the turret jig and after it is clamped it is just a matter of pulling the pins which hold the turret in the correct position and turning the turret to suit the hole which is to be drilled and tapped. By the use of this jig we save on each set of four straps 8 hours and 20 minutes, or in dollars and cents, $1.25 per engine. This jig is patented.

Fig. 5 shows a style of taper reamer much used for various jobs where it is necessary to keep a number of holes one size, such as crown bolt holes, air pump piston heads, etc. The bushing A is threaded to screw onto the body of the reamer, B, which can have two or four ¼″ slots or keyways milled along the threaded portion for set screw C to fit in. In this way it is possible to get a close adjustment and make a fool-proof reamer. It can only go in up to where the bushing is set.

Fig. 6 shows a style of gauge used for calipering wheel centers and tires. The outside caliper is the correct size and the length of the inside one is minus the allowance for shrinkage. The two hooks shown are bent so that the inside rod rests in one and the catch slips over and holds the same in place so as to keep them together when not in use.

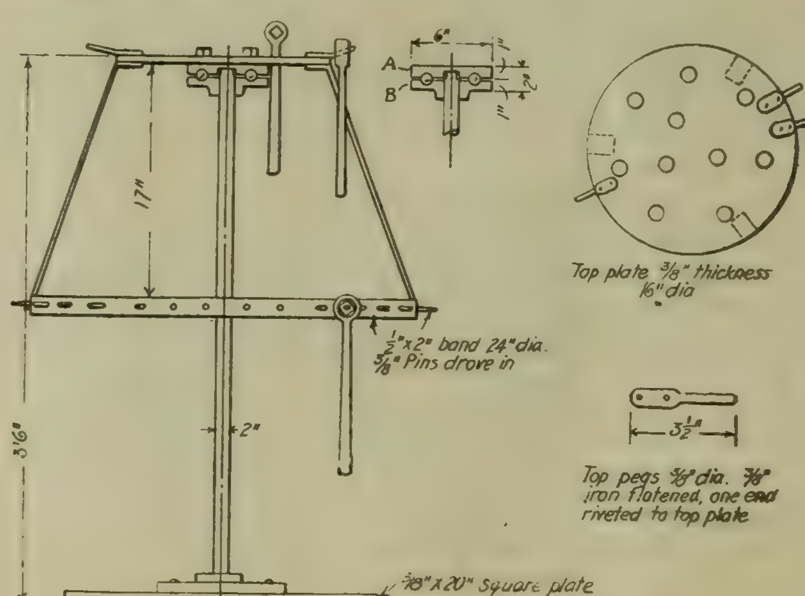


Fig. 7—Handy Tap Wrench Rack.

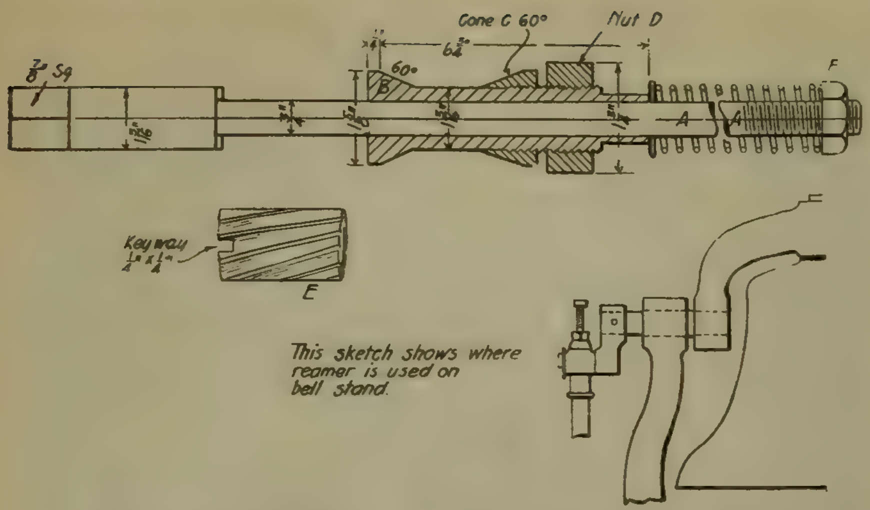


Fig. 8—Handy Device for Reaming Out Bell Stands.

A handy tap wrench rack is shown in Fig. 7. The top plate is fastened to the band by three ½"x2" braces, bent and riveted to to same. The top flange is riveted to the top plate which rests on a stationary flange and pedestal. A groove is cut in both flanges and ⅜" balls inserted. The bottom flange is driven onto a 2" round stem, which stem enters the top flange about ⅝" to help steady the revolving parts. Ratchet wrenches can be slipped through 1½" holes in the top plate.

Fig. 8 is a handy device for reaming out bell stands without removing them from the boiler. Shaft A is made of machinery steel of suitable length. Cone bushing B slides over shaft A and cone C slides along cone bushing B. When used, cone bushing B is inserted in the hole of the yoke or stand, cone C slipped on and tightened by nut D, which brings it central. Shell reamer E is slipped on shaft A, which is then passed through the outside hole and bushing in the yoke. The spring is then tightened by a split nut at F and the reamer put through by motor or hand. After the hole is reamed out, the device is unloosened and adjusted on the other side; the operation then being repeated. Shell reamers can run in 64ths with a back spiral of 1" in 14".

Fig. 9 is a gauge for obtaining quickly the diameter of anything cylindrical. It is made of a cylindrical piece of machinery steel, having an inside diameter at one end of 1½", which tapers down to 1¼" at the other end. There is a 3/32" slot extending nearly the whole length along one side. The taper is so graduated that a series of 15 marks spaced ¼" apart give a difference in diameter of 1/64" at each mark. The hole has a taper of ¾" per foot.

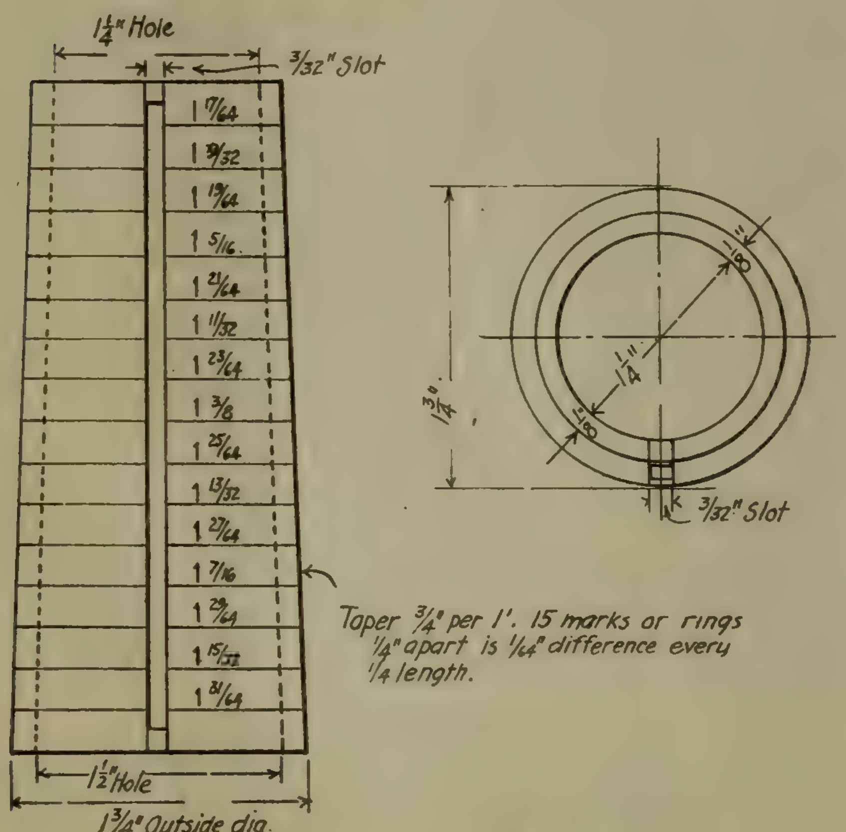


Fig. 9—Handy Gauge for Cylindrical Objects.

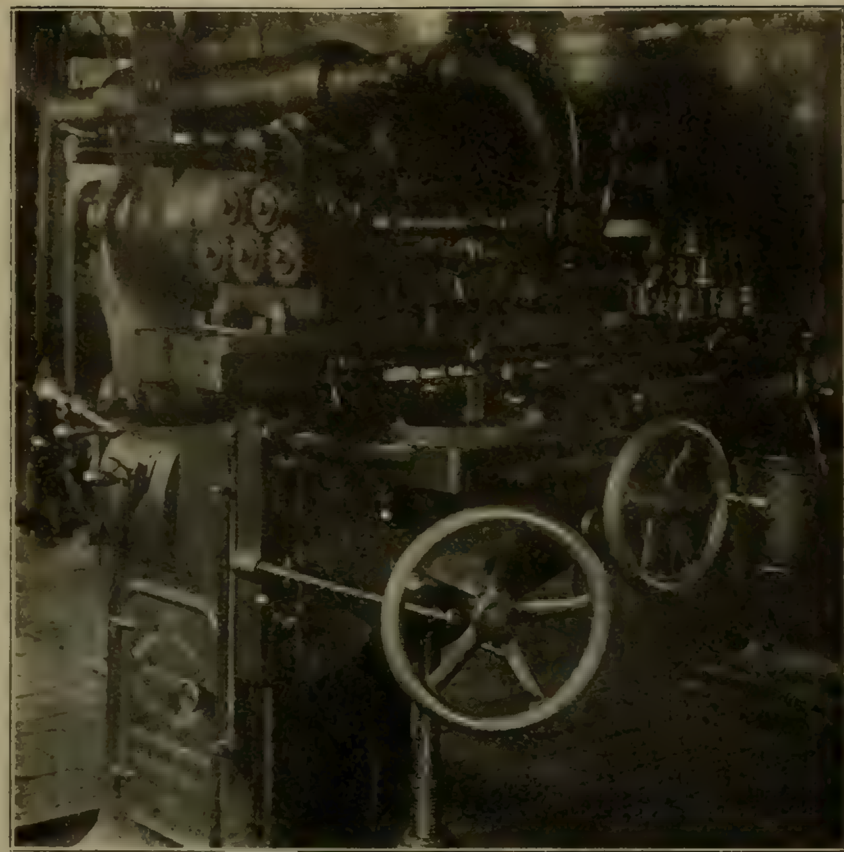


Fig. 10—Triple Device Milling Three Expanders at Once.

Fig. 10 shows a triple device for milling three reamers or rose-bits at once. It is shown cutting three expanders and is quite a labor-saving device.

Fig. 11 is a ball bearing tool rack, the construction of which may be easily understood from the illustration.

Our tool checking system is as follows: Each new man on entering the service is given a key number and the tool room then issues to him eight brass tool checks corresponding to his key number. After drawing a tool, his check is put in its place. The checking board has the names and key numbers of all employes so that we can tell at a glance to whom a check belongs. A workman on leaving the employ of the company has to have a clear-

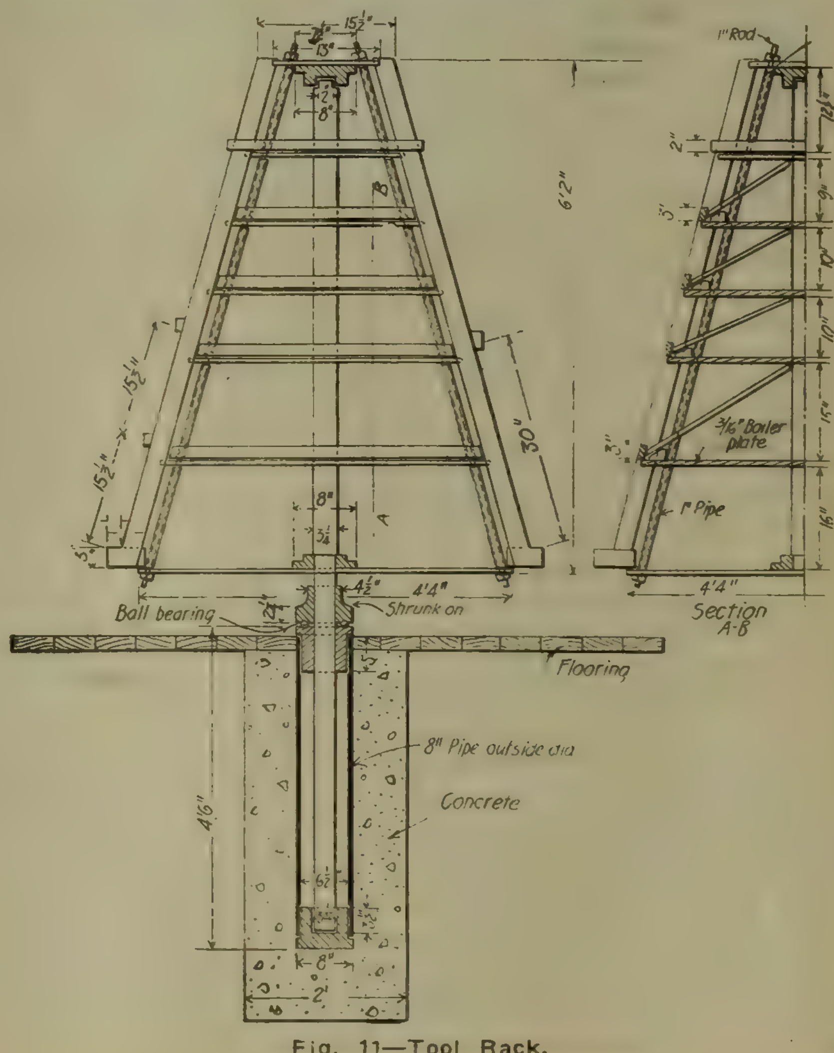
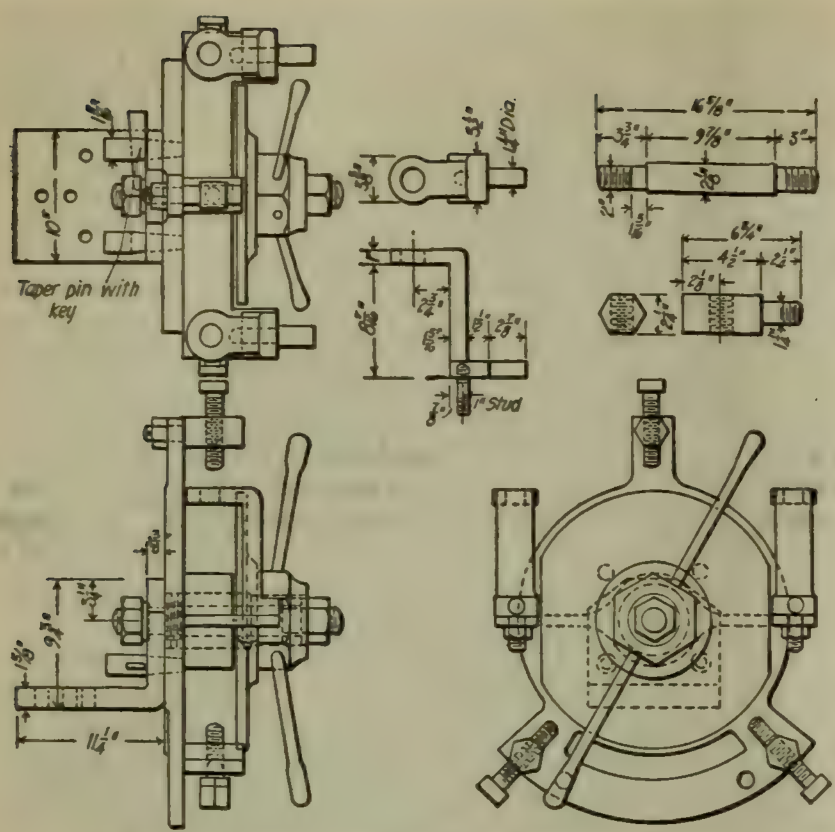


Fig. 11—Tool Rack.



Jig for Tapping and Drilling Eccentric Straps.

ance from the tool foreman before he can get his time. All tools are required to be returned to the tool room every night, if circumstances will permit.

SUCCESS.

When a small man gets into a position too big for him, he begins to swell. This is not a comfortable process, and it spoils his disposition.

You will be quite assured of this if you attempt to be friendly with anyone in this predicament, on the grounds, perhaps, that you knew him in the old days when he was a mortal. He will soon put you in your proper place, and you will return, a sadder and a wiser man, to the Old Farm.

Very small people indicate their realization of their own shortcomings by talking very large indeed. They bluster in the endeavor to distract attention from their deficiencies; they use language in great quantities, to conceal thought. The open space between the man and the job, however, is sadly noticeable.

You may recognize a big man by his simplicity and lack of ostentation. Being bigger than his job, instead of smaller, he is not overpowered by its dignity. Indeed, he considers his own reputation in the eyes of his fellows more important than the reputation of his position.

He is quiet, simple, unassuming, friendly; and yet there is a mysterious something that squelches the too-eager advancer, and makes it unnecessary to turn on the cold water.

It is very good to be big, no matter how small the position you occupy. If mentally and morally one is larger than one's work, the world very soon finds this out, and advancement comes, up to the point where the job is as big as the man.

There advancement stops.

Fortunately, there is such a thing as growth, and while the big man is advancing, he is also growing. So that he is always just a bit bigger than his job.

This is what we call success.—*Drill Chips.*

THE CENTRAL RAILWAY CLUB at its September meeting listened to a paper on "Locomotive Arch Brick," by George Wagstaff, of the American Arch Co. The paper described the materials used in the manufacture of arch brick, namely, flint clays, plastic clays and calcined clays, after which the writer outlined the manner of making the bricks. A short sketch of recent developments of the brick arch was given in which it was stated that there are now between 29,000 and 30,000 engines in the United States and Canada equipped with fire brick.

THE LOCOMOTIVE STOKER.*

By Clement F. Street.

The firing of a locomotive with a shovel is the most crude operation being performed on our railways today. This seems to be quite generally recognized as is shown by the almost continuous series of experiments which have been carried on during the past twenty years, with a view of producing a successful locomotive stoker. When these experiments were first begun, it was with the idea that the stoker would be, primarily, a fuel saving device, and its labor-saving features were considered as secondary. With the advent of the large locomotive this view has changed, as the limit of the size of the locomotives which could be built has been fixed by the capacity of a man to shovel coal. With the advent of the successful stoker, this limit has been removed, and it is now possible to build locomotives to burn any quantity of coal which may be desirable. In addition to this, the use of the stoker has increased the capacity of many locomotives already in service. The question of capacity is today the first consideration, and any question of fuel saving, although important, has become secondary.

THE SUCCESSFUL STOKER IS HERE.

The successful locomotive stoker is here. Locomotive stokers in substantial numbers are now in regular daily successful operation and are considered an essential part of the equipment of the largest locomotives being built. The B. & O. has about 220 stokers in use, the Pennsylvania Lines about 300, the N. & W. about 140, the C. & O. about 80, the C. B. & Q. about 65, the Hocking Valley 11, the Virginian 7, and the D. M. & N 8, the El Paso & Southwestern 6, the B. R. & P. 6, the New York Central Lines 5, and some six or eight other roads are using them experimentally.

The Baltimore & Ohio has just placed in service 30, and the C. B. & Q. 25 locomotives of the 2-10-2 type, which have a tractive power of about 71,000 lbs. and which would never have been built had it not been known that a stoker could be secured which would fire them properly.

J. R. Gould, general superintendent of motive power of the Chesapeake & Ohio, has designed, had built, and just placed in service six Pacific type passenger locomotives, which are known to be beyond the capacity of any one man to fire in the service for which they are intended, and they would not have been built had it not been known that a stoker could be secured which would fire them properly.

The Norfolk & Western has 105 Mallet locomotives fitted with stokers, and which could not be shovel-fired in the service in which they are used.

In a published interview regarding the Erie Railway "centipede" type locomotive, S. M. Vauclain, vice-president of the Baldwin Locomotive Works, makes the following statement:

"This type of locomotive would never have been suggested, however, were it not for the fact that we are now able to feed a locomotive boiler any amount of coal up to its capacity to burn it. Thus the human equation heretofore preventing the use of large power units has been overcome, and it is my belief that we are just beginning to enter the field of large power units for freight service of the trunk lines of this country. If it can be proven that we can operate locomotives of 150,000 pounds tractive effort, with the same engine crew as heretofore and with less physical exertion on the part of the fireman than with the locomotive of only 50,000 pounds tractive effort, it would appear reasonable that such units of power will be in demand, not only by the railroad companies but by the employees as well."

The fact that the above locomotives have been built and that additional ones of equally large dimensions are being designed, together with the large number of stoker-fired locomotives now in regular daily operation, proves conclusively that the locomotive stoker is no longer an experiment, and that it is a practical success.

WHAT IS A SUCCESSFUL STOKER?

It is not at all a difficult matter to fire a locomotive with a stoker and it does not seem to be generally known that practically

*A paper delivered before the Western Railway Club, Oct. 20, 1914.

every stoker ever applied to a locomotive has fired it and done a very good job. The Kincaid, which was one of the first brought out, did an excellent job of firing, and about 50 of them were applied, so did the Heyden and the Strouse, and upwards of 70 of the latter were built and applied to locomotives. These and a number of others have failed, but not because they would not fire a locomotive. The second machine which I built did as good a job of firing as any stoker I have ever seen, but it would never have been a success. The actual firing of a locomotive is only the beginning, and a very small beginning, of the solution of the problem of producing a successful stoker.

We see frequent statements that some one has brought out a new stoker which has fired a locomotive over a division without opening the fire door and without hooking the fire. This means nothing to any one who has followed the development of the stoker, as we all know that nearly every machine experimented with has at some time done this on one locomotive working under unknown conditions and with the stoker in the hands of an expert.

No stoker can be considered as having passed the experimental stage until at least 100 of them are in regular service and in pooled locomotives. If my stoker was ever near the point of being a failure it was after I had over 200 of them in service, as it was only after this number were in use that I really began to find out what the machine would and what it would not do.

A locomotive stoker of the scatter type in order to be a successful and a commercial machine must do, if not all, at least most of the following:

1st. It must not break down.

2nd. It must do at least 90% of all manual labor in taking coal from the tender and distributing it over the grate.

3rd. It must distribute coal evenly over the grate and provide means for firing heavy on any one section or zone in case the locomotive does not burn an even fire.

4th. It must be constructed so that the fireman can at any time inspect the fire, rake it, and do shovel-firing without shutting off the stoker.

5th. It must have several definite and marked rates of feed, have a capacity in excess of the maximum requirements, and feed coal continuously at any definite rate at which it is set and maintain that rate regardless of variations in steam pressure or grade amount or condition of the coal fed to it.

6th. It must be constructed so that feeding to it bolts, spikes, rocks and any other foreign matter which may be in the coal will not result in a breakage and so that such matter or articles can be removed without taking the machine apart, in case they cause a clog.

7th. It must have all parts easy of access for making inspection, repairs and lubrication.

8th. The cost of inspection and running repairs must not be in excess of 75 cents per 100 locomotive miles.

9th. It must be so simple in construction that the average fireman can understand the function of each part and be able to operate it successfully, after having received instructions during only one or two trips over a division.

10th. It must have the opening through which coal is admitted covered with a screen which will reduce to a minimum the liability of the admission of foreign matter which will cause clogs.

11th. It must handle wet coal.

12th. It must keep a locomotive hot under all conditions with a lower grade of coal than is required for shovel-firing.

1st. It must not break down.

The first requirement of a successful stoker is reliability. The machine must not break down, and any machine which is liable to frequent break-downs is foredoomed to failure. This is true, even with a machine which does not obstruct the fire-door and which can be shovel-fired. With this type of machine it is possible, of course, for a fireman to take the shovel and bring his train to a terminal, but if the locomotive is loaded to its full capacity its speed will necessarily be greatly reduced, and he will obstruct the entire road.

The fire carried by a stoker is much lighter than with shovel-firing; the exhaust nozzle is larger for a stoker-fired locomotive, and a fireman, who has been trained to stoker-firing, finds it very difficult indeed to take up hand-firing, or, if he has formerly been hand-firing, go back to it. Consequently, it is of vital importance that a stoker be reliable, and not subject to failure.

2nd. It must do at least 90% of all manual labor in taking coal from the tender and distributing it over the grate.

Several attempts have been made to introduce stokers with which the fireman had to shovel all the coal into a hopper. This is an impractical proposition because a stoker is primarily a labor saving device and unless it saves at least 90% of the manual labor of firing a locomotive it does not meet the primary requirement of a stoker. With a successful machine the fireman becomes a machine operator instead of a coal shoveler and if he still has to shovel an appreciable amount of coal, his time is so much occupied in doing this that he does not have sufficient opportunity for watching the operation of the machine, making necessary adjustments and seeing that it is working properly.

3rd. It must distribute coal evenly over the grate and provide means for firing heavy on any one section or zone in case the locomotive does not burn an even fire.

Very few locomotives will burn a fire evenly all over the grate and a successful stoker must, therefore, be constructed to meet this characteristic and feed continuously and steadily a larger proportion of the coal to that section where it is burning heavy than to the section where it is burning light.

4th. It must be constructed so that the fireman can at any time inspect the fire, rake it, and do shovel-firing without shutting off the stoker.

A successful stoker fireman will at all times know just what condition his fire is in and he can do this only by making frequent inspections of it. If it is so hot he cannot see it he will run the hook in and feel it. With the best of machines and under the most favorable conditions it may be found that a few shovels of coal added at a certain place will help out materially, and conditions are liable at any time to arise which make this absolutely essential for securing the best operation.

A fireman who fires a locomotive over a division without opening the fire door, or making a careful inspection of his fire by some other method which will give him an equally good opportunity for so doing, is not doing a good job of stoker-firing. In order to secure the best results the fire should be thoroughly inspected at least every thirty minutes, and the stoker should be constructed so that this can be done without interfering in any way with its operation and certainly without shutting it down.

5th. It must have several definite and marked rates of feed, have a capacity in excess of the maximum requirements, and feed coal continuously at any definite rate at which it is set and maintain that rate regardless of variations in steam pressure or grade amount or condition of the coal fed to it. A throttle control will not do this, as there is a sufficient variation in the load placed on the stoker to have this control make wide variations in the speed at which the machine runs and delivers coal to the fire-box.

The driving engine of a stoker, under normal conditions, is working at not more than four or five horse power. A piece of slate, or large lump of coal, or some foreign substance entering the machine, will immediately double or treble the load on the stoker engine. With a throttle control, this will invariably result in the machine slowing down, or stopping, with a corresponding reduction in the amount of coal fed to the fire-box. There must be some sort of an automatic governor on this engine, which will take care of these wide fluctuations in the load. Without this, a fireman will never know the rate at which coal is entering the fire-box, and is working entirely in the dark. The requirements placed on a modern locomotive in freight service are altogether too strenuous to allow of depending upon uncertainties. A fireman must have some means of knowing just what his machine is doing; also, he must be able to duplicate results; that is, after having made a trip over the road, he must be able to take the same machine, or another machine of the same design, set it to do the

work which he knows it has done before, and know that he will duplicate results. If he cannot do this, he must spend a considerable length of time when starting out on a run and getting his machine adjusted and working properly, while with definite information, he knows just what the machine will do, and can start right from the terminal. A right kind of a start is always important on any job, but it is vital to a locomotive stoker.

6th. It must be constructed so that feeding to it bolts, spikes, rocks, and other foreign matter, which may be in the coal, will not result in a breakage, and so that such obstructions can be removed without taking the machine apart, in case they cause a clog.

One of the things a stoker designer has to figure on is the fact that it is impossible to keep foreign matter out of a stoker. It makes no difference what precautions may be taken in providing screens, or other protection, some foreign matter is bound to get through. Of course, a great many articles, such as small bolts, nuts, and other things which will go through the machine, will cause no trouble whatever, but on the other hand, a great many such things as bolts, spikes and waste will clog the machine, and unless all the parts are made of ample strength, will cause breakage. The properly designed machine should be able to withstand without breakage the feeding to it of an obstruction which will stop it instantly. In order to do this, all of the different parts of the machine must have more strength than the engine, and the only result of a clog of this nature must be that the machine will stop. This is a pretty severe requirement on any machine, but it is being met and must be met by any machine which is a success.

7th. It must have all parts easy of access for making inspection, repairs and lubrication.

One of the most important characteristics of a stoker is that it shall be easy to inspect and lubricate. Like any other piece of machinery, it must have regular and systematic inspection, lubrication and care. It is of vital importance, therefore, that all parts of the machine shall be easy of access, and located where they can be inspected in a minimum length of time. A machine should be built so that an inspector can start it up, inspect all its working parts and see that it is in operating condition, in not more than ten to fifteen minutes. If it takes a greater time than this, the inspection will not be what it should be. One inspector should be able to care for a full equipment of stokers in one round-house; if this inspection can be made in a period of fifteen minutes or less per machine, he can easily do so, but if it required a greater time than this, he will not be able to get around, and some of the machines will be neglected.

8th. The cost of inspection and running repairs must not exceed 75 cents per 100 locomotive miles.

There are records of a number of locomotive stokers having been in regular daily service for a period of over two years without a single failure or receiving repairs of any nature. These machines are now superseded by those of improved design and it can be confidently expected that records of this kind will be the rule rather than the exception with the improved machines. The average cost of inspection and repairs to the old machines, where records have been kept, is from 50 to 60 cents per 100 locomotive miles and it is expected that the cost on the new machines will be even less than this, but 75 cents is a good, safe figure which any well designed machine should come well within.

9th. It must be so simple in construction that the average fireman can understand the function of each part and be able to operate it successfully, after having received instructions during only one or two trips over a division.

There is a remarkable difference in the way different men take to stoker-firing. Some of them seem to comprehend the entire mechanism at a glance, and will make a successful run the first trip over the road. In fact, there are numbers of cases on record where they have made their first trip without an instructor and without having the machine even explained to them. This has been done, however, with a machine which has each feature of adjustment located so that the effect of each change can be seen, and its effect at once noted. This is very important, and levers, rods and valves leading to hidden attachments should be studiously avoided.

10th. It must have the opening through which coal is admitted covered with a screen, which will reduce to a minimum the liability of the admission of foreign matter, which will cause clogs.

All coal, when it comes from the mines, is liable to contain track spikes, bolts, slate, rocks, and other foreign matter, and while in the tender, is liable to have other things added to it. At one time, half a keg of track bolts were dumped into a stoker. Pieces of ties are frequently found, and a small piece of hard wood can make a lot of trouble if it gets in the right place for so doing. A piece of waste is a very bad thing, and is liable to be in most any pile of coal on a tender. A coal pick or a monkey wrench, or a hammer, can do considerable damage. Without a screen over the tank opening, any of these things, if in the coal, are almost sure to get into the stoker, but if a good, substantial screen is provided, it is very seldom that any of them get through, and if they do, they are of dimensions too small to cause a serious clog, or a breakage.

11th. It must handle wet coal. Some of the coal being used in stokers contains so much dirt that when it becomes wet it forms a sticky paste, which will not run and which plasters onto anything it comes in contact with, and forms a hard cake as it dries. This is about the hardest proposition the stoker has to contend with, but the successful machine must handle it, and is doing it.

12th. It must keep a locomotive hot under all conditions and with a lower grade of coal than is required for shovel-firing. One of the first things to be discovered in experimenting with the stoker was the fact that it was possible, with it, to burn a poorer grade of coal than could be used with shovel-firing. This is true with stationary boilers as well as locomotives. As a result of this feature of stokers, large quantities of coal which were heretofore considered refuse, and thrown in dump piles, have been gathered up and burned under stationary boilers, and the same thing is being done on locomotives.

A stoker which requires as good a grade of coal as is used for shovel-firing, under the same conditions, has never been a success on a stationary plant, and it is not believed it ever will be on a locomotive. One of the problems which the railways are always up against is that of poor coal, and a properly designed locomotive stoker will eliminate practically all complaints of poor coal. If it will not do this, it is not meeting one of the principal requirements of such a machine.

It is not my desire to exaggerate the difficulties of stoker-firing a locomotive, or to set forth specifications which are needlessly severe, and in the above I have tried to outline my personal opinion of what a locomotive stoker should do. There are a great many features which could be added to this list and which are desirable, although, in my opinion, not essential.

With a scatter type of stoker, the tendency is for a considerable proportion of the dust and finer particles to be carried out of the stack by the heavy draft, and in order to secure the best results from this type of machine, some provision should be made to prevent this. One of the methods, which has been successfully employed, is to provide a screen, which takes out the dust and finer particles, and deposits them across the back end of the bridge. This is considered a very important feature of a stoker of this type, and while a machine not having it will undoubtedly fire locomotives successfully, it will certainly not give as good fuel economy as a machine having this feature. If, therefore, the best results as to fuel economy are to be obtained, something of this nature must be provided.

A large number of locomotive stokers are now in regular daily service doing all of the different things outlined above, and there is no reason why any well-designed stoker of the scatter type should not meet all of these requirements.

WHAT SIZE OR CLASS OF LOCOMOTIVES SHOULD HAVE STOKERS?

It is very evident that in the near future all locomotives in main line train service will be fitted with stokers, but the question today is where to begin, and to which class should they be applied first.

This question can be answered in two ways:

First. It can be confidently stated that, under average conditions, any locomotive, freight or passenger, which has a maximum tractive power of 50,000 pounds or over, should be fitted with a stoker.

Second. Any freight locomotive, which burns 4,000 pounds or over, of coal per hour, continuously, for periods of one hour or over, should be fitted with a stoker.

There are a large number of freight locomotives, having less than 50,000 pounds maximum tractive power, which are burning 4,000 pounds of coal per hour or over, and are harder to fire than others having a greater tractive power. There are freight locomotives of over 50,000 pounds tractive power, which are not burning 4,000 pounds of coal per hour, for periods of one hour or more, are not being worked to their full capacity, and it might be questioned whether they need stokers in the class of service in which they are working. It is not usual to find this latter condition, as any such locomotive, if worked to anywhere near its full capacity, is burning over this amount of coal, and should have a stoker.

In passenger service there are very few locomotives of over 50,000 pounds tractive power which are not fitted with stokers, and they all should be, if it is expected to work them to their full capacity, as it is out of the question to do so with shovel-firing. A fireman in passenger service, however, can shovel a much larger amount of coal per hour than he can in freight service, because the length of time which he must work is so much shorter that he is not liable to become exhausted before reaching the end of a division.

WHAT IS TO BE GAINED BY THE APPLICATION OF STOKERS?

A locomotive is the only thing on a railroad which earns money. When all the locomotives on a railroad are being worked to their full capacity, the earning power of that railroad is at its maximum. Any reduction in the rate at which the locomotives of a railroad are working, or the number working, means an immediate and corresponding reduction in the earnings of that railroad.

The primary object of applying a stoker to a locomotive is to enable the operation of that locomotive to its full capacity at all times and under all conditions, and this object is being attained wherever stokers have been applied.

There are only a few places where stoker-fired and shovel-fired locomotives of the same dimensions have been worked on the same division, and in the same class of service. Wherever this has been done the stoker locomotives have hauled a greater tonnage, and at a higher speed, than was possible with the shovel-fired locomotive.

On one division of a railroad, with Mikado type locomotives, having a tractive power of 54,000 pounds, the tonnage rating, without superheaters, and with shovel-firing, was 4,750 tons. Superheaters were applied and the rating was made 5,000 tons. Stokers were applied and the rating was made 5,250 tons; then 5,500 tons, 5,750 tons, and it is now 6,000 tons; at the same time the rating of the shovel-fired superheaters was pushed up to 5,500 tons. It was found, however, that it was not practical to run shovel-fired and stoker-fired locomotives on the same division, as even with the less tonnage, the speed of the former was so much less than that of the latter that they could not keep out of the way, were continually delaying traffic, and now all trains on this division are being hauled by stoker-fired locomotives.

On another division of the same road, before stokers were applied, these locomotives were hauling 5,000 adjusted tons. After the stokers were applied, this tonnage was gradually increased to 6,500 tons, and at one point on the division, with a river grade, they are hauling 85 to 115 all-steel, 70-ton coal cars, giving a tonnage of from 8,600 to 8,900 tons.

On still another division of the same road, fast freight trains with shovel-fired locomotives, were made up of from forty-five to fifty loads. After the application of stokers these trains were increased to eighty-five and ninety loads, and better schedule time is being made than was possible with shovel-fired locomotives and the lighter trains.

At another point on this same road, fast freight trains are being run over two divisions—a total distance of 187 miles—with the same engine crew. Before the stokers were applied, the firemen were always changed at an intermediate point, and sometimes the engineer. This better service is partly owing to the less amount of work required from the firemen, but mainly to the much higher rate of speed which is being maintained. With shovel-fired locomotives, at lower speeds, it was a common occurrence for these trains to be unable to make the two divisions without exceeding the 16-hour law. With the stoker-fired locomotives they have no difficulty whatever in doing this.

On other roads, having Mikado locomotives of upwards of 60,000 pounds tractive power, attempts were made to shovel-fire them, and the best they could do was to haul about 5,000 tons. Now, stokers are being used exclusively on these locomotives, and the regular rating is 6,000 tons. There is not a single case where successful stokers have been applied to freight locomotives wherein there has not been a material increase in the tonnage rating, and this is the main reason for, and the principal advantage to be gained from the application of stokers.

The reason that this increased tonnage is possible is the fact that the fireman can secure and maintain the maximum steam pressure on his boiler at all times and under all conditions. It is not an uncommon occurrence, on heavy freight trains hauled by the locomotives referred to above, for the engineer to work his cylinders at full stroke, with the throttle wide open, both injectors on and maintain a speed of 18 miles an hour. There is no difficulty in maintaining full steam pressure under these conditions and at this speed. It would be impossible for one fireman, or any number of firemen to do this with the shovel, as the continual opening of the fire-box door reduces the fire-box temperature to a point which makes full steam pressure impossible.

In spite of the increased tonnage, there has always been an increase in the average speed of heavy freight trains, which is a great advantage where the traffic is heavy. As a result of this, the train dispatchers are some of the strongest advocates of stokers, as they say with stoker-fired locomotives they can handle the traffic much more rapidly than with shovel-fired. This increased train speed results in a marked reduction in the over-time of train crews, as with the stoker-fired locomotive it is very exceptional for them to exceed the 16-hour law.

Another advantage which follows the use of stokers is in that the time required for cleaning fires, both at terminal and on the road, is very much reduced. A stoker fire clinkers much less than a shovel fire, and statistics show, as a result of this, that it requires less than one-half as much time to clean a stoker fire as it does a shovel fire.

The stoker is to a locomotive very nearly what the automatic feed is to a machine tool. An automatic feed on any machine tool always has resulted in an increased output and better work done by that machine tool. A machine job is always a better job than a hand job. With hand work there are necessarily introduced inaccuracies, wide variations in results, and undesirable conditions from every standpoint. This applies just as much to a locomotive stoker as it does to the automatic feed on machine tools. With the stoker, the wide variations in steam pressure and quantity of coal burned are, to a great extent, eliminated. This is true, not because it cannot be done with shovel-firing, but because the average fireman will not do it. This is only natural, as a long continued repetition of the same operation, even when it is not hard labor, becomes burdensome and monotonous, and so long as the human machine is constructed as it is, its efficiency will not hold up under a long continued strain. On the other hand, the efficiency of a machine is always the same.

There has been a great deal of discussion on the question of fuel saving by locomotive stokers, and in some quarters there is an impression that a stoker-fired locomotive will burn more coal than a shovel-fired. The actual results show very clearly that, under average condition, with an equal grade of coal, a stoker-fired locomotive will not burn any more coal than a shovel-fired, in proportion to the amount of work done. It is, however, an invariable rule, that stoker-fired locomotives are worked harder than shovel-fired, and are also given a poorer grade of coal. On many roads using

stokers, they are giving the locomotives fitted with them a grade of coal which is so poor that it cannot be used successfully for shovel-firing at all. I do not know of a single instance where stoker-fired and shovel-fired locomotives are running side by side with the same tonnage, same speed and same grade of coal. In every case the tonnage and speed are increased, and the grade of coal is poorer when the stokers are used. As a result of this, the coal consumed per hour is, of course, greater with the stoker-fired than with the shovel-fired. The coal consumed per unit of work done, however, is altogether a different question, and the work done by a stoker-fired locomotive is usually so far in excess of that which can be done by a shovel-fired that it is impossible to make a comparison.

This same thing applies to the amount of water evaporated per pound of coal. The boiler of a stoker-fired locomotive is, as a rule, not worked at as economical a point as one which is shovel-fired, and the rate of evaporation is, therefore, not so good. I regret very much to have to say that there are no absolute figures to demonstrate this. On all roads which are using any appreciable number of stokers, the question of fuel saving has been given very little, if any, consideration, as the advantage to be gained by the increased tonnage and increased speeds is so great that any questions of fuel economy sink into insignificance in comparison with it.

Please do not understand me as attempting to belittle the question of coal economy, as it will, in the long run, be a very important consideration in connection with stoker-firing, and as more machines are placed in service, the stoker-firing becomes more general, it will be given more and more consideration. At the present time, however, the first question is that of capacity of locomotives. After this has been thoroughly developed, and we learn just what we can do along this line with the stoker, the question of fuel economy will be given more consideration, and in addition to this, many other questions, such as simplicity of construction, cost of repairs, and general efficiency of stokers will become more and more important.

It has been stated that one of the objections to a stoker on a locomotive is that it makes it too easy to waste steam through the safety valve. My reply to this is that a fireman who will waste steam through the safety valve with a stoker will do the same thing with a shovel. A railroad officer put this argument very hard to me as being a very bad feature against the stoker, and the next day, on his own road, I heard the safety valves on a switch engine blow full open for seven hours without closing once. During that same period a large number of trains, both freight and passenger, came into the same terminal, and the pop valves on every locomotive, without exception, were wide open, and not one of them was stoker-fired. If the firemen were doing this with a shovel, what would they do with a stoker if this objection be valid? The fact of the matter is that there is less reason for waste at the pop valves with stoker-fired than with shovel-fired locomotives, because the fireman has better control of his fire. With shovel-firing he must leave a terminal with a heavy fire and full steam pressure, but with a stoker he can start out with very little fire, so long as it is clean, with his steam pressure from 15 to 25 pounds shy, and feel confident that he can have full pressure within ten or fifteen minutes at any time, and without regard to how the locomotive is worked. In fact, he knows the fire cannot get away from him—that he is absolute master of the situation at all times—and can control it without physical exertion.

PREPARED COAL.

In order to secure the best results from stoker-firing a locomotive with bituminous coal, the physical characteristics are more important than the chemical analysis, and better results are often secured from coal of inferior quality, in proper physical form, than from that of a better grade, in improper size. The ideal coal for stoker-firing is secured by passing run of mine coal over a screen with about two-and-one-half inch square openings. Ordinarily, this gives about twenty-five to thirty per cent of fine slack, or dust, and the remainder in lumps of all sizes, up to two-and-one-half inches. When coal of this character is spread over the grate by means of the scatter type stoker, it gives a uniform, even fire, and produces very rapid combustion. In order to secure the full capacity of a locomotive boiler, this rapid combustion is absolutely essential. The modern locomotive, when working to its full capacity, must burn at least 100 pounds of coal per square foot of grate, per hour, and many of them require as high as 150, or even 175 pounds.

If coal is to be burned at the rate of from 100 to 150 pounds of coal per square foot of grate per hour, it is vital that it be all very nearly of a uniform size, as any lumps of 3, 4, 5 or 6 inches applied to a stoker fire will result in uneven burning of that fire, and in unsatisfactory results. A lump of these dimensions, lying in the fire, will take much more time to ignite and burn than the remainder of the coal, and is, therefore, sure to make an uneven fire and cause trouble, and if it does not cause trouble, will not produce as good results as can be produced with coal of more uniform dimensions.

When I introduced my first locomotive stoker, I insisted on having coal of the above characteristics. I also insisted that coal prepared in this way should be furnished on the tank, and that a crusher on a tank was a bad proposition and should be avoided. I am confident that the success which is now being enjoyed by the scatter type stoker is largely owing to the fact that this was insisted upon. As yet, I see not the first reason for making any change in my views on this subject, and am more than ever convinced that any scatter type of stoker, which attempts to use run of mine coal on the tank, will never be a success.

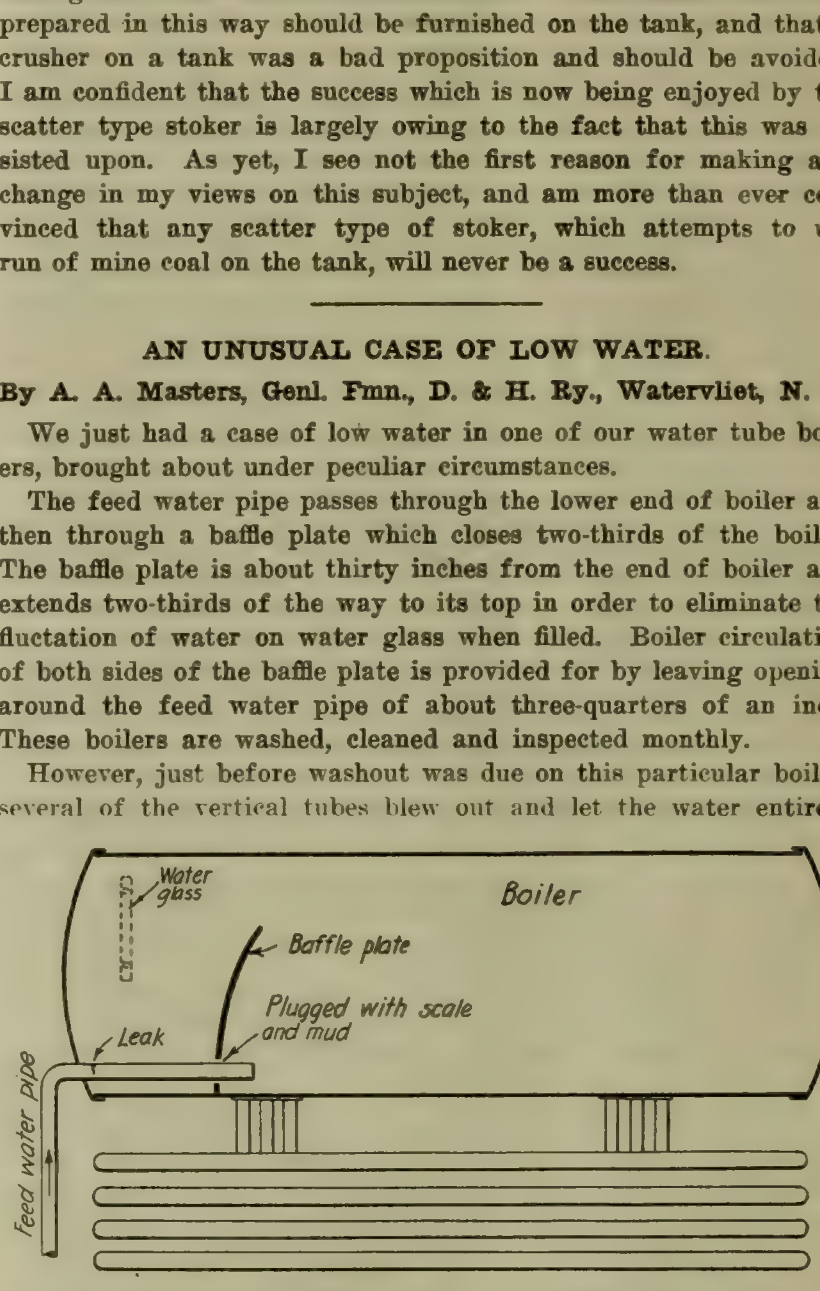
AN UNUSUAL CASE OF LOW WATER.

By A. A. Masters, Genl. Fmn., D. & H. Ry., Watervliet, N. Y.

We just had a case of low water in one of our water tube boilers, brought about under peculiar circumstances.

The feed water pipe passes through the lower end of boiler and then through a baffle plate which closes two-thirds of the boiler. The baffle plate is about thirty inches from the end of boiler and extends two-thirds of the way to its top in order to eliminate the fluctation of water on water glass when filled. Boiler circulation of both sides of the baffle plate is provided for by leaving opening around the feed water pipe of about three-quarters of an inch. These boilers are washed, cleaned and inspected monthly.

However, just before washout was due on this particular boiler, several of the vertical tubes blew out and let the water entirely



Diagramatic Sketch of Low Water in a Water Tube Boiler.

out of the boiler. Examination showed water two-thirds of the way to the top of the glass. Further investigation, however, showed that where the feed water pipe passes through baffle plate, mud had accumulated, entirely closing this hole and leaving only the space over the top of baffle plate open.

A leak had developed in the feed water pipe just inside the end of boiler and the result was that when feed water was passing into the boiler, the space between the baffle plate and end of boiler was filled before the boiler became filled to water level. Evaporation also took place more rapidly beyond the baffle plate than at the end, causing water to show in the water glass when there was little or none in the boiler, which resulted in the boiler becoming burned.

We are now guarding against this by cutting six additional two inch holes through the bottom of the baffle plate.

Properties, Treatment and Selection of Iron and Steel*

By James H. Herron, Consl. Engr., Cleveland, O.

Each new year brings to our attention startling developments in the composition, treatment and use of iron, steel and other alloys, so that what we think we know today, may be of little use tomorrow.

One of the difficulties that engineers have met with in the use of data relative to iron and steel, and their treatment, has been in the very general character of the numerous books written and the articles appearing in the technical press upon the subject. When the treatment of the subject has been sufficiently exact in its detail to be of use, the instructions could only be applied to some problem entirely foreign to the one in hand, and to modify the treatment to suit the needs might be somewhat hazardous. Unfortunately it is extremely hard to handle this subject in any but a general way, and the engineer must learn to apply the principles to his particular problems. The subject can best be handled by taking the different materials in the order in which they are the most familiar to the engineer.

CAST IRON.

Cast iron is an alloy of iron and carbon, the latter varying from 2.2 per cent to 4.00 per cent, depending in part upon the conditions of smelting and in part upon the impurities present. The characteristic qualities of cast iron are, in fact, all due to the presence of the large amount of impurities in it. The influence of these impurities will be considered as follows:

The carbon in cast iron is found in two forms, graphitic and combined, the proportion of which influence the physical properties of the metal. When the graphitic carbon is in excess the fracture is greyish in color and the iron is known as grey iron. When the combined carbon is in excess the fracture is either mottled or white, and is known as either mottled, or white iron. This latter depends upon the amount of combined carbon present.

Of the impurities present in iron, graphite is unique, inasmuch as it is rarely found in other metals. It is present in the form of flakes or thin plates, in sizes varying from microscopic proportions to approximately ⅛ square inch in area, disseminated throughout the body of the metal and forming an intimate mechanical mixture. A magnified section of grey iron with graphitic carbon in excess is shown in Fig. 1. The graphite is represented by the dark areas and the iron is indicated by the light areas. This shows clearly how the flakes of graphite destroy the continuity of the metallic mass. The composition of this iron was as follows:

	Per cent.
Carbon (Graphitic)	2.87
Carbon (Combined)	0.16
Manganese	0.42
Sulphur	0.096
Phosphorus	0.566
Silicon	2.02.

This shows high graphitic carbon, and indicates a weak structure.

There is a question whether the graphite crystallizes out between the grains of the metal or merely fills in the interstices between the grains of the metal after they are formed. While the graphite may be but 3.00 per cent by weight, this amount would represent about 12 per cent by volume. It therefore covers an appreciable part of the effective area, consequently, weakening the structure in proportion to the amount present, but rendering the metal more easily machined. Graphite also tends to decrease the shrinkage of cast iron, but at the same time increases the porosity.

Grey iron castings usually contain 2.00 per cent or more of graphitic carbon and the remainder combined carbon.

Combined carbon is found in all grey iron to a less or greater extent in the form of iron carbide or cementite. The tendency of combined carbon is to render the metal hard. The structure of combined carbon is shown in Fig. 2 which is a highly magnified section of the combined portion of grey iron. In the structures, the light portions represent carbide of iron and the dark portions iron. When a large proportion of carbon is in the form of combined carbon the iron is white. White iron has little value owing to its hardness, except where it is to be given some subsequent treatment.

There is some question of the influence of the various proportions of graphitic carbon and combined carbon on the strength of iron. When the total carbon is constant the strength doubtless increases with the combined carbon up to about 1.00 per cent from which point it would fall off as in the case of steel. It is generally found that the influence of the carbon in its various forms on the strength of cast iron is somewhat uncertain.

Of the numerous elements entering into cast iron as impurities, silicon has perhaps the greatest influence. It varies from less than 1.00 per cent to 3.50 per cent and its presence has much to do in influencing the physical properties of the metal. Silicon is commonly known as a softener owing to its influence upon the condition of the carbon present. By means of his control over silicon and sulphur, the foundryman exercises his greatest control over the physical condition of the metal. Silicon possesses the property of precipitating the carbon present, driving it out of the combined form and into the graphitic form. With as much as 3.00 per cent of silicon present, with a slow cooling and low sulphur and manganese, a grey iron may be obtained with almost no combined carbon.

By its control over the carbon, silicon has a marked influence upon the shrinkage. There are times when the shrinkage is exceedingly important and may be the dominating factor. W. J. Keep in his book on Cast Iron (published by John Wiley & Son) has carefully computed from experiments, and plotted in the form of a diagram, the relation of silicon to strength and shrinkage. Excess silicon also tends to coarsen the structure of the metal.

The effect of sulphur upon cast iron is directly opposite to that of silicon, that is, each increase in the sulphur present tends to increase the amount of combined carbon in the iron. It is usually considered that 0.01 per cent of sulphur neutralizes 15 times as much silicon, i. e., equals 0.15 per cent silicon in its effect upon the condition of the carbon in the iron.

Sulphur also makes the iron hot short or brittle when hot, so that high sulphur iron shows a greater tendency to check or shrinkage crack in cooling than low sulphur iron. The amount of sulphur should therefore not exceed some pre-determined limit. For this reason a limit for sulphur is usually made a part of specifications for grey iron castings.

Manganese increases the total carbon in pig iron and also increases the proportion of carbon in the combined state, although

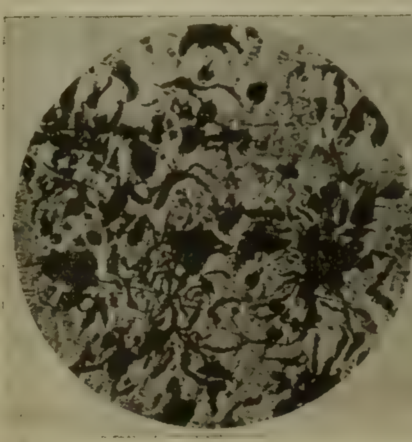


Fig. 1.

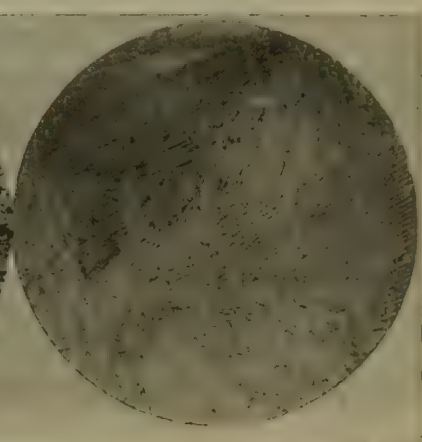


Fig. 2.

*A paper read before the Cleveland Engineering Society.

its influence is much less than sulphur. Manganese tends to neutralize the effect of the sulphur in increasing the combined carbon. There should be enough manganese present in the iron to veil the sulphur.

Phosphorus tends to increase the combined carbon, especially when the silicon is low and the phosphorus high. It also has the effect of lengthening the time of solidification, or tends to slower cooling and therefore neutralizes its own effect by giving more time for the separation of graphite. This is a condition of greater fluidity.

It will be seen from the above that all the impurities present in cast iron, only in a greater or less measure, influence the condition of the carbon present, which is the alloying element and which confers upon the iron its properties. The specifications for grey iron castings adopted by the American Society for Testing Materials in 1905 give a good guide for the buyer of iron castings. The sulphur content and the description of the classes of castings, together with the tensile strength, are given as follows:

The sulphur contents to be as follows:

Light castings	not over 0.08 per cent
Medium castings	not over 0.10 per cent
Heavy castings	not over 0.12 per cent

In dividing castings into light, medium, and heavy classes, the following standards have been adopted:

Castings having any section less than ½ inch thick shall be known as light castings.

Castings in which no section is less than 2 inches thick shall be known as heavy castings.

Medium castings are those not included in the above classification.

Tensile Test: Where specified, this shall not run less than:

Light castings	18,00 lbs. per sq. in.
Medium castings	21,000 lbs. per sq. in.
Heavy castings	24,000 lbs. per sq. in.

It will be noted that the burden of the composition falls upon the foundryman. Unfortunately all foundrymen do not take the precautions necessary to know their raw material and many castings are delivered that are either coarse grained or too hard to machine.

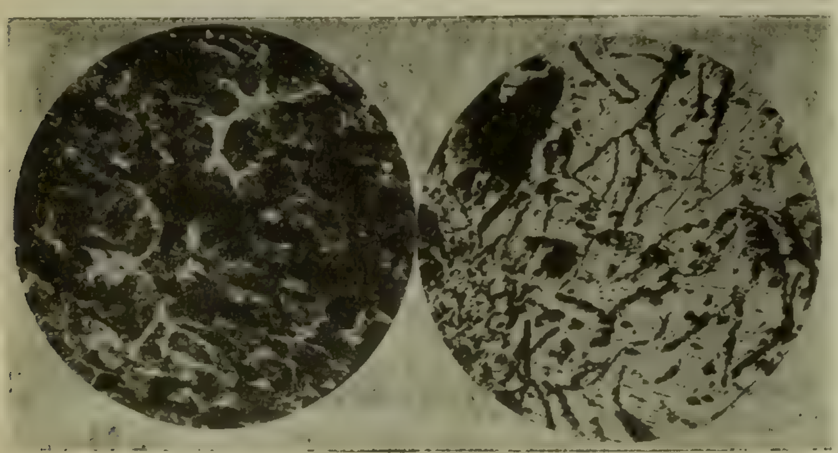


Fig. 3. Fig. 4.

SEMI-STEEL.

We have a class of iron castings known as semi-steel, where wrought iron or soft steel scrap is used in the melt. The added steel present tends to reduce the total carbon and silicon and decrease the amount of graphite present. Whether the combined carbon is increased is hard to determine; probably not. Thomas Turner in the Journal of the Society of Chemical Industry gives the strength of cast iron with additional wrought scrap as follows:

100 parts cast iron; 10 parts of wrought iron increases the strength 2 per cent.

20 parts of wrought iron increases the strength 32 per cent.

30 parts of wrought iron increases the strength 60 per cent.

40 parts of wrought iron increases the strength but 33 per cent.

The maximum result is therefore produced with 30 per cent of wrought scrap. Fig. 3 shows a semi-steel and as will be noted the amount of graphite carbon present is less than shown in Fig. 1.

HEAT TREATMENT OF CAST IRON.

The simplest form of treatment for cast iron is annealing, when the castings are too hard for machining. This is especially true of thin castings. Heating above the critical range and slow cooling tends to the formation of graphitic carbon. Fig. 4 shows a photomicrograph of a structure of material of the following composition:

	Per Cent
Carbon (graphitic)	3.88
Carbon (combined)	0.08
Manganese	0.47
Sulphur	0.104
Silicon	1.36

The silicon content in this iron is desirable for cylinder castings, but by the slow cooling from annealing the carbon has been practically all precipitated in the graphite form, leaving but 0.08 per cent in the combined form. The structure resulting from a condition of this kind is very weak and is unfit to resist an appreciable tensile stress.

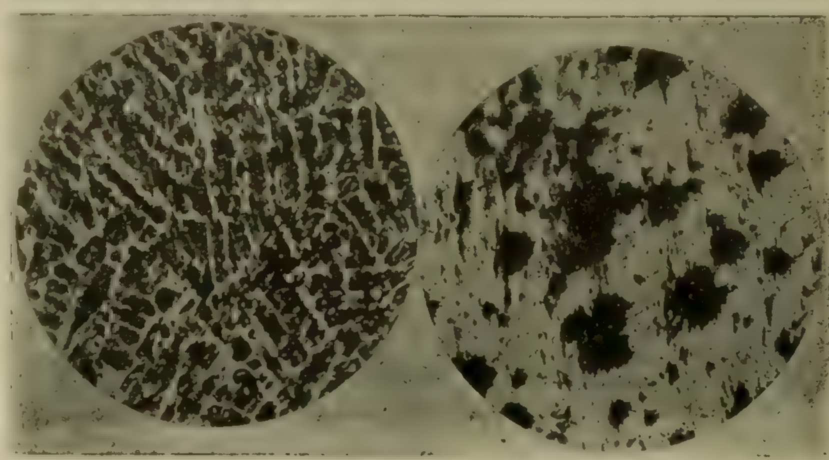


Fig. 5. Fig. 6.

The most important heat treatment given cast iron is the malleablizing process. It was not until the advent of metallography that the nature of the changes taking place in the process was understood. Malleable iron has physical properties between iron and steel castings. The iron is melted either in a cupola, or air furnace and cast into shape as in iron castings. After cooling, the fracture would be all white in the smaller pieces and white with the center mottled in pieces of 1 in. or more in thickness. This structure is shown in Fig. 5, which is malleable iron untreated. It will be noted that the carbon in this material is practically all in the combined form, which is necessary to the best results in the process. After castings are cleaned, they are packed in annealing pots and heated to a temperature of from 1,500 to 1,750 degrees and kept at that temperature for about 60 hours. Under these conditions the carbon is precipitated in the form of graphite, not in flakes as in grey iron, but in the form of finely divided particles, probably spherical in shape, to which the name of tempered graphite is given. Fig. 6 shows the appearance of this graphite gathered together in approximately circular areas.

The appearance of the fracture gives to this casting the name of "black heart." When malleable castings are annealed in mill scale, iron ore, or other oxidizing substances a thin decarbonized rim of from 1-64 to 1-16 of an inch in thickness is produced. When the packing material is of a neutral or reducing character the appearance of the castings are black throughout. Such castings do not possess the strength of the white rimmed castings.

The so-called "white heart" castings produced abroad are made only in light sections where the decarbonization is carried on throughout the entire casting.

Malleable castings will vary in ultimate strength from 30,000 to 50,000 pounds per square inch and with a slight elongation and reduction of area. The specifications in part for malleable castings as adopted by the American Society for Testing Materials are as follows:

Castings for which physical requirements are specified shall not contain over 0.06 per cent sulphur nor over 0.225 per cent phosphorus.

The tensile strength of a standard test bar for castings under specification shall not be less than 40,000 pounds per square inch.

The elongation measured in 2 inches shall not be less than 2½ per cent.

Malleable castings shall neither be "over" nor "under" annealed. They must have received their full heat in the oven at least 60 hours after reaching that temperature.

WROUGHT IRON.

Owing to the comparatively small amount of wrought iron now manufactured, and the seeming difficulty experienced in getting the genuine article, it hardly seems necessary to indulge in an extended discussion relative to the effect of the various impurities. When ready for market it is frequently impossible to distinguish wrought iron from soft steel. A chemical analysis or miscroscopical examination is sometimes necessary to properly classify them. Owing to its low physical value and relative high cost, wrought iron is now rarely used in structural or machine parts; it finds its greatest value where resistance to corrosion is an important factor, such as sheets, pipes, etc.

In the puddling process the iron is melted in a bath of liquid cinder. The cinder adheres to the small particles or is gathered together in appreciable areas. In the refining process some of the cinder is worked out of the material, but enough remains to identify the iron by its presence. These cinder inclusions are shown in the dark areas in Fig. 7.

The advocates of wrought iron claim that the slag or cinder present forms a covering for the grains of iron, thereby protecting them from the action of the elements. Laboratory tests for corrosion seem to be of little value since the condition to which the material would be subjected cannot be duplicated in such tests.

It is unfortunate and due to the high cost that a greater supply of wrought iron is not available for general purposes, since there are many uses to which it could be put to greater advantage. The usual specifications for wrought iron are as follows:

	Lbs. Per Sq. In.
Tensile, not less than	48,000
Yield point, not less than	25,000
Elongation in 8 in. in per cent	22

OPEN HEARTH IRON.

Certain manufacturers are offering open hearth iron as substitutes for wrought iron and claim certain properties, such as resistance to corrosion, etc. Open hearth iron is made in the open hearth furnace at a high temperature and is therefore considerably overheated in the manufacture. In the form of sheets this condition of overheating is probably rectified in the subsequent annealing, but in bars the material possesses a coarse structure and shows what is known as a "fiery fracture."

The working temperature of open hearth iron is comparatively limited; it must be worked at a comparatively high heat, resulting in the coarse crystalline structure as above noted. Where the temperature falls below this point the iron is brittle and is therefore not susceptible to mechanical refining. Open hearth iron has little to recommend it except for use in sheets and other parts where final annealing of the material is possible. Fig. 8 shows the structure of open hearth iron. The coarse structure is evident. The analysis of this material is as follows:

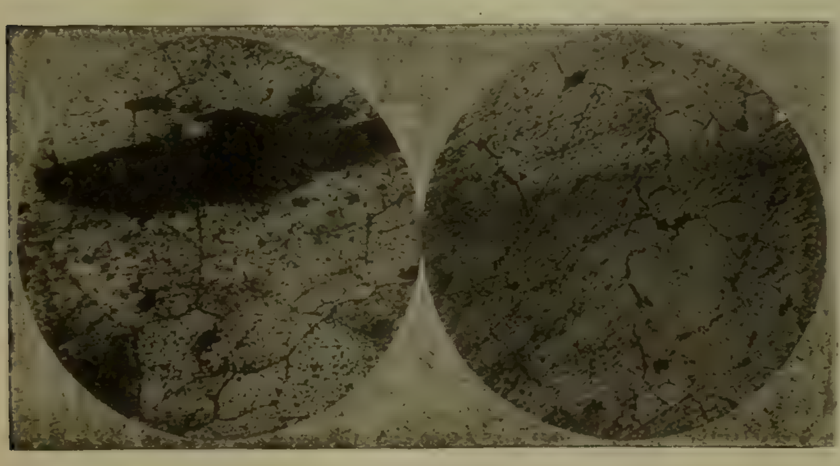


Fig. 7. Fig. 8.

	Per Cent.
Carbon	0.070
Manganese	0.028
Phosphorus	0.006
Sulphur	0.021
Silicon	0.027
Total	0.152

It will be noted that the amount of impurities is low although the oxygen content is probably high.

STEEL.

Steel, like cast iron, is an alloy of iron and carbon, or iron, carbon and other metals. The dividing line between steel and cast iron is at a carbon content of 2.2 per cent, i. e., all iron with a carbon content greater than this amount is cast iron, and all under this amount is steel or wrought iron.

The physical properties of steel are greatly influenced by the amount of carbon, alloying elements and impurities present. The process of manufacture has much to do with the value of the metal for various purposes. We will not go into a discussion of these various methods, but will more particularly consider the selection of steel from the physical properties, together with the chemical, inasmuch as the latter influences the physical.

Of the various elements entering into commercial steels, some are of value while others are a decided detriment. The value of the steel physically is determined largely by these elements pro and con. Not only should their presence be considered, but the amount of each should be accurately determined. They will be taken up in the order in which they are usually considered.

The general influence of carbon on steel is greater tenacity. It also renders the steel harder and stiffer. The tensile strength is increased from 600 to 800 pounds per square inch for each additional point of carbon, while the ductility is decreased about 0.5 per cent for each additional point of carbon. Steel having a carbon content of 0.20 per cent begins to show an appreciable hardening effect when cooled quickly. Steel in the normal state will begin to show evidence of brittleness when the carbon has reached approximately 0.70 per cent. The greatest value of steel dynamically is probably with a carbon content of approximately 0.35 per cent.

Manganese increases the tensile strength of steel by about 100 pounds per square inch for each additional point, while the ductility is probably somewhat decreased, but this is not marked. For medium steel the manganese content is usually from 0.40 per cent to 0.60 per cent. Higher or lower manganese may be specified for special purposes, depending upon the amount of other impurities, although for steel to be heat-treated, especially in the presence of high carbon, high manganese is objectionable. Steel with manganese of more than 1.00 per cent should be avoided, owing to its increased hardness and tendency to brittleness, except in special cases. Manganese enters into special steel as an alloying element where the quantity is greater than 5.00 per cent. The so-called manganese steel of market has a manganese content varying from 7.00 per cent to 12.00 per cent.

Phosphorus increases the strength of steel, but owing to its tendency to render the metal cold short or brittle, it should be considered as an impurity and avoided as much as possible. The lower the phosphorus content the better, with a possible exception of spring steel, where there is frequently a minimum limit specified. For constructional purposes, steel should be specified with phosphorus not to exceed 0.04 per cent which is the general specification for open hearth steel. Where a structure is subjected to only a condition of static loading, Bessemer steel may be acceptable and the phosphorus content limited to 0.08 per cent.

Sulphur has a tendency to render the steel hot short and is therefore to be avoided in any steel that is to be forged or otherwise worked hot. Sulphur is detrimental to steel that is to be quenched in any way. The quality of hot shortness is likely to

cause much trouble, especially in material that is to be case hardened or otherwise heat-treated. The sulphur for good results should not exceed 0.06 per cent. This is the limit in Bessemer steel. It is much better to keep the sulphur content below 0.04 per cent which is the generally accepted specification for open hearth steel.

Silicon is generally supposed to render steel cold short or brittle, but there is little evidence that silicon in a small quantity will do this. In ordinary steel the silicon is usually limited to 0.20 per cent but there are special silicon steels where the silicon content may exceed 2.00 per cent. As an alloying element silicon tends to increase the tensile strength but decrease the elongation and reduction of area.

Nickel in steel has a strengthening effect or tends to increase the value statically with the nickel present from 1.00 per cent to 5.00 per cent and in proportion to the amount present. In low carbon steel the unit increase is about 5,000 pounds for each 1 per cent of nickel present. High carbon steels show more gain than low carbon steels. With a nickel content of 3.50 per cent of which much steel is used, and in the annealed condition, its presence tends to increase the elastic limit from 50 per cent to 75 per cent depending upon the amount of carbon present. By proper heat treatment of the material the above values may be raised as high as 100 per cent over steel where the nickel is not present.

Nickel tends to increase the strength of the material without decreasing the ductility, which is perhaps its important feature. It also tends to increase segregation, but somewhat retards the absorption of carbon in the case carbonizing process.

Chromium in steel tends to make it intensely hard and give it a high elastic limit in the hardened or suddenly cooled state, so that it is neither deformed permanently nor cracked by extremely violent shocks. It is stated that the hardness imparted by chromium in steel is not accompanied by as much brittleness as that induced by carbon; owing to this property it has a wide adaptability for machine parts that are to be extremely hard or subjected to great pressure. The chromium varies in quantities from 0.3 per cent to 3.00 per cent.

Chromium tends to accelerate the case hardening process and much steel containing chromium is used in this way for certain purposes.

It was not until about the year 1900 that the effect of vanadium in steel became generally known. Before that time it was especially used in tool steels. This was due to scarcity and, consequently, the high cost of vanadium, prohibiting its use in the different kinds of ordinary steels. Vanadium owing to its affinity for oxygen and nitrogen, combines with these gases when they are either free or united with some other element where the bond is weaker than with vanadium. This results in compounds of vanadium with oxygen and nitrogen which pass off with the slag thus removing from the steel the objectionable oxides and nitrides.

In addition to the above, vanadium seems to possess the property of retarding segregation, thereby rendering the material more homogeneous. It also seems to possess an intensifying effect on the other alloying elements, *i. e.*, it renders the effects of these elements greater than in steels without vanadium, but otherwise of a similar composition.

Vanadium is seldom used in steel without some other alloying element present in considerable quantity, and in the so-called vanadium steels the resistance of fatiguing stresses is high.

All steels are divided into, Binary, Ternary and Quaternary alloys.

Binary alloys are those which have one alloying element in addition to iron. This may be carbon or any other element. Since carbon is nearly always present in alloys of iron, carbon steel is therefore a typical binary alloy.

Ternary alloys, are those which have two alloying elements in addition to iron as above stated. Since carbon is invariably present in iron alloys it is therefore one of these elements. Example of ternary alloys are as follows:

Nickel steel.
Chromium steel.
Manganese steel.
Titanium steel.

These alloying elements can be present in any desired quantity and the alloy takes its name from the third alloying element.

Quaternary alloys, in the same way, would be alloys having three alloying elements in addition to the iron. Again as carbon is one of these the remaining two are as found in

Chrome-Nickel steel.
Chrome-Vanadium steel.
Silico-Manganese steel.

The alloying elements may be present in any proportion, the alloy taking its name from the third and fourth element.

ANNEALING.

Annealing is not always considered a heat treating operation although it is in reality such. In annealing, the material is heated to a temperature slightly above the critical point and permitted to cool slowly.

There is a softening operation which is frequently called annealing and comprises the healing of the material to a temperature slightly below the critical point when it is either permitted to cool slowly, or is quenched. The latter is known as "water annealing." The length of time that castings or other large parts are heated for annealing is very important in order that all structural changes may take place at the proper temperature.

HEAT TREATMENT.

Heat treatment, as generally understood, comprises the heating of the steel to a temperature slightly above the critical point; quenching in oil or water; reheating to some temperature to give the desired physical properties and cooling slowly. The initial temperature to which the material is treated is very important and should not greatly exceed the critical point. The effect of high temperatures on grain size is shown in Figs. 9 and 10. This is a soft commercial steel and shows the influence of the heating temperature upon the structure of the material.

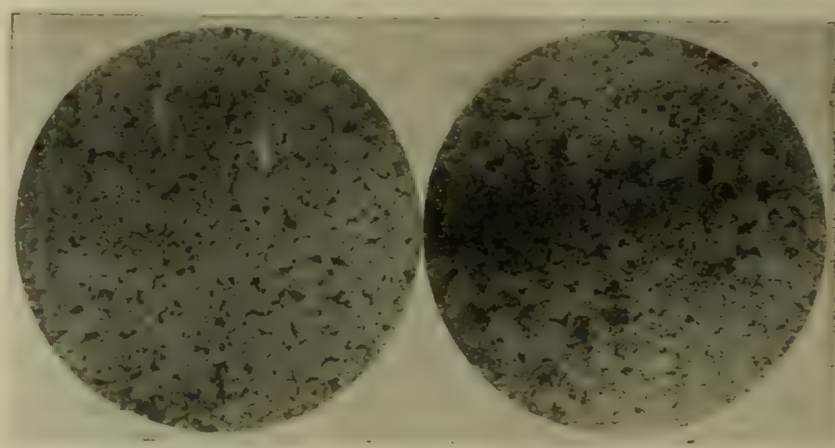


Fig. 9. Fig. 10.

The importance of determining the correct temperature and exercising the greatest care in heating cannot be over emphasized. This is especially true of the higher carbon and alloy steels. If the value of the steel is not actually impaired, a resulting condition may occur which would render the treatment valueless.

The physical properties of the heat treated material are influenced by the final re-heating temperature, and should it be desired to have a high elastic limit with little ductility the temperature is selected along the lower range of the scale. Should great toughness be required the higher ranges are selected, depending upon the degree desired. In this way a selection is made of the material and the heat treatment given to meet a specific physical condition. Alloy steels, with few exceptions, should be heat treated, since their best properties are otherwise lost.

Heat treatment may be carried one point beyond the above treatment and, for certain purposes, the more elaborate treatment may be justified. This involves a second quenching and tends to give the steel a fibered structure.

One of the most important forms of heat treatment is case carbonizing or so-called case hardening. Steel to be carbonized is

packed in some carbonaceous material and heated for a given length of time at temperatures varying from 1,600 to 1,750 degrees F., depending upon the depth of penetration of the carbon desired. It is impossible to give any rule for the penetration, since the nature of the carbonizing medium, the temperature at which the heat is run and the material used, are important factors in determining the depth of case. Many of the earlier writers gave rates of penetration of the carbon per hour, which might have been justified where only one carbonizing medium was known. Now almost any rapidity of penetration desired may be obtained by varying the material, carbonizing mixture and time. It is necessary to pre-determine the length of run for the particular conditions existing by using several test pieces and pulling them from the furnace at frequent intervals until the depth of case required

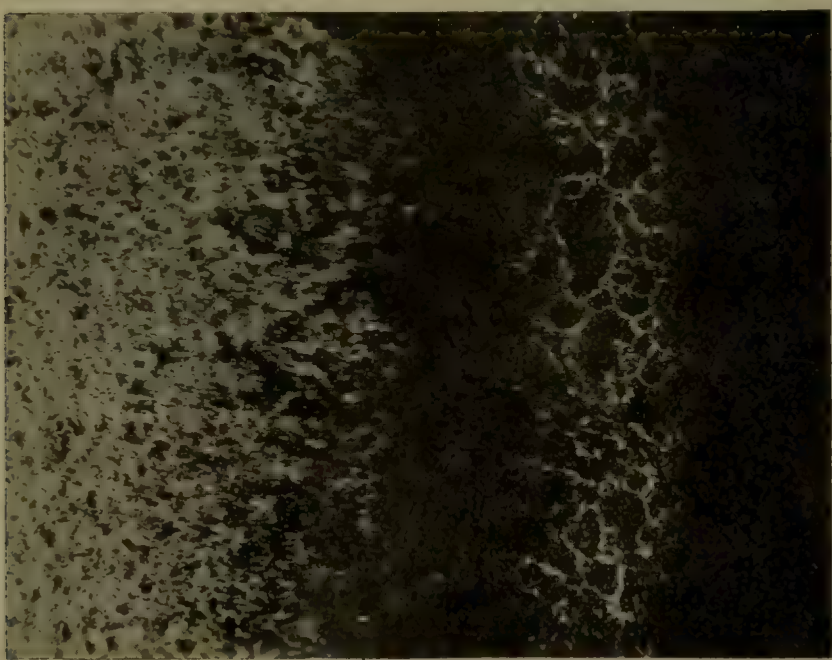


Fig. 11.

is obtained. Fig. 11 is a photomicrograph of case carbonized steel showing clearly the outside zone, where the cementite is in excess; the eutectoid zone composed of pearlite and the graduated zone tapering off from the eutectoid composition to the composition of the base material.

In much case carbonized work, such as gears, and where it is subjected to shock, the carbonizing should be done under conditions of time and temperature, that the carbon content of the outside zone can be as near the eutechtoid composition as possible. This would overcome largely the possibility of chipping or flaking which is common to case hardened parts under certain conditions of service and when the carbon in the outside case is greatly in excess of the eutechtoid.

It is always well, especially if good properties are desired, to permit material to cool in the carbonizing mixture. It has become common practice to give case carbonized parts a double heat treatment, i. e., heat for the refinement of the core, quench in oil, subsequently heat at a lower temperature for the refinement of the case and quench in water, after which the material may be drawn to the extent necessary for the physical properties desired. From results obtained in gears, this practice does not seem to be necessary, if the carbonizing temperature be comparatively low, say about 1,600 degrees. In this case the parts are permitted to cool in the carbonizing boxes, are re-heated to refine the case or to a temperature of about 1,350 degrees. This confers upon the material, properties which seem to be about equal to those which are conferred by the double heat treatment. Under these conditions parts may be with a fair degree of success quenched from the carbonizing heat.

Mr. Andrew Gleason of the Gleason Works, Rochester, N. Y., in a paper presented before the National Machine Tool Builders' Association, October, 1913, gives the following report of tests for strength of gear teeth—hardened and soft. It represents average results which were gotten from a considerable number of test pieces in the different kinds of steels referred to. All test pieces were spur pinions, with 14 teeth, 6 pitch, 2⅓ in. pitch diameter, 1-inch face and 1-inch bore. Teeth were of standard depth and shape and were held in a chuck with load on edge of tooth.

The initial displacement or elastic limit was determined by following up the load with a venier tooth caliper. All carbonizing $\frac{1}{32}$ inch deep with the furnace heat showing 1,450 to 1,500 degrees Fahr. for 8 hours and 1,600 degrees for 3 to 5 hours, a total of 11 to 13 hours.

20 Carbon O. H. Case Hardening Steel:

No.		Elastic Limit, pounds.	Breaking Strain, pounds.
1	Soft	3,500	.....
2	Case hardened with one tempering heat 1,450 deg.; 90 scleroscope hardness	8,400	9,000
	Same drawn to 400 deg.; 85 scleroscope hardness	8,000	9,450
3	Case hardened with two tempering heats 1,600 and 1,450 deg.; 85 scleroscope hardness	8,200	9,675
	Same drawn to 400 deg.; 80 scleroscope hardness	8,000	9,800

One and One-Half Per Cent Nickel 18 Carbon. Natural Alloy Steel:

1	Soft	4,000	.....
2	Case hardened with one tempering heat; 92 hardness	9,000	10,150
	Same drawn to 400 deg.; 87 hardness	8,600	10,450
3	Case hardened with two tempering heats	8,750	10,600
	Same drawn to 400 deg.; 82 hardness	8,400	10,750

Three and One-Half Per Cent Nickel 13 Carbon. O. H. Nickel Alloy:

1	Soft	4,000	.....
2	Case hardened with one tempering heat 1,350 deg.; 90—95 hardness	9,700	11,400
	Same drawn to 400 deg.; 85 hardness	9,400	11,850
3	Case hardened with two tempering heats 1,550 and 1,350 deg.; 90—95 hardness	9,500	11,650
	Same drawn to 400 deg.; 85 hardness	9,250	11,950

Five Percent Nickel 15 Carbon. O. H. Alloy Steel:

1	Soft	4,500	.....
2	Case hardened with one tempering heat 1,350 deg.; 90 hardness	13,000	13,880
	Same drawn to 400 deg.; 85 hardness	12,700	14,800
3	Case hardened with two tempering heats 1,550 and 1,350 deg.; 90 hardness	13,000	14,100
	Same drawn to 400 deg.; 85 hardness	12,800	14,850

Chrome Nickel Tempering Steel calling for heat treatment as follows:

1	Quenching heat 1,425; draw 475; 65—70 hardness	Broke at 22,450. No set before breaking.
2	Soft	Elastic limit 5,000 lbs.

Chrome Nickel Tempering Steel calling for heat treatment as follows:

1	Quenching heat 1,480; draw 525; 75—78 hardness	Broke at 17,640. No set before breaking.
2	Quenching heat 1,480; draw 850; 60—65 hardness	Broke at 19,400. No set before breaking.
3	Soft	Elastic limit 5,200 lbs.

In conclusion he states that the increased strength as the result of the double heat treatment after carbonizing is comparatively slight, particularly in the nickel steels. This is doubtless due to the long and low carbonizing heats that were used. The stock for these particular experiments was selected for case hardening, based upon the experience of the Gleason Works, and according to their experience he stated that the ordinary machinery steel with the same carbon content would vary in some cases, twice as much as the results given by the test. He also stated that the natural nickel alloy steels are subjected to a variation similar to the carbon steels, while the special steels selected, or the high

grade alloy steels used, did not vary more than 10 per cent either way from the figures given in the report.

This same rational treatment in case hardening can be applied to all parts. Case hardening is particularly necessary where selective hardening is required. The parts desired to be kept soft can be copper plated or covered with fire clay or certain kinds of enamel. This same method can also be employed where a much greater depth of case is desired in one part than in another part of the material.

STEEL CASTINGS.

Perhaps it might be well to touch briefly on steel castings, inasmuch as they are not regarded in quite the same way as the rolled or forged material. Insofar as the composition is concerned, steel castings can be regarded very much as any other steel; the influence of the impurities present in the material will be the same, as also the introduction of alloying elements.

In the heat treatment of steel castings, proper annealing is of the greatest importance. Unfortunately commercial annealing is not what it should be, and if much is expected from the material it should be properly annealed or heat treated. By heat treating large steel castings with the carbon range of 0.20 to 0.60 per cent the elastic limit can be increased about 50 per cent with little decrease in the ductility. Some interesting tests on the treatment of steel castings is presented by C. F. Young, C. D. A. Pease and C. A. Strand in the February bulletin of the American Institute of Mining Engineers. These are the result of some tests at the Pennsylvania shops at Altoona. Steel castings for general use should not exceed a carbon content of 0.35 per cent.

SELECTION OF MATERIAL FOR SPECIFIC NEEDS.

The selection of material for any purpose is one of satisfying a definite physical need. This may be one of strength, regardless of size, or one of toughness at a given strength, or again may be one depending upon limited space or weight, or whether it must be cast or can be forged, etc.

Before proceeding in the selection of material for specific needs a careful analysis should be made of the conditions under which service must be rendered and the stresses to which the particular part will be subjected. These stresses may be static, dynamic, or a combination in varying degrees of both, and the extent of each and of any character, as tension, compression, torsion, etc. The condition of weight and space is very important where possibly a gear of a given size must transmit a given power without overloading. The first condition then in selecting steel is one of the proper analysis of the condition and stresses to which the part is to be subjected.

In the selection of castings it becomes a matter of deciding whether they shall be of iron, semi-steel, malleable iron, or steel. In castings that are only subjected to a condition of static loading and where no limits of space or weight are prescribed, iron castings answer the purpose in every way. They not only offer the easiest problem in castings, but are subject to less shrinkage and are much easier to machine than castings made from other material. For this reason iron castings are satisfactory to use in machine parts and form the bulk of such castings. There are, of course, conditions of loading where it is not one of static condition, but in a measure dynamic, as in the steam engine, but the rate of change in the stress is uniform and the reversal of stress takes place in an appreciable length of time so that it may be considered perfectly feasible to use castings of this character if a unit stress is selected sufficiently low. Steam engine builders allow a very low unit stress on all cast iron. In machine design, unit stresses allowed are inversely proportioned to the service expected. Many designers do not exceed a unit stress of 2,000 pounds for ordinary conditions, assuming that the requirement varies from zero to a maximum minus. Owing to the high value positively of cast iron, the compressive stress is usually regarded as negligible. In steam cylinders or other containers for an elastic flued, the unit stress is often as low as 400 pounds. As a rule castings are subjected to a stress as above given, *i. e.,* from zero to a maximum plus or minus. This condition of loading has not in the past been considered one of dynamic character, but it is, nevertheless. Engineers, while not generally recognizing such condition, allowed for it in the low unit stresses assumed.

Generally in iron castings it is well to follow reliable specifications as those adopted by the American Society for Testing Materials. If special results are desired, composition may be selected to meet the need; also selective chill may be resorted to for various degrees of hardness.

Where a greater strength is required than in cast iron, the semi-steel casting can be resorted to, and it seems to give satisfactory results. There is a question whether semi-steel castings can be depended upon to show a consistent ductility. There are tests of these castings which show an appreciable elongation, although

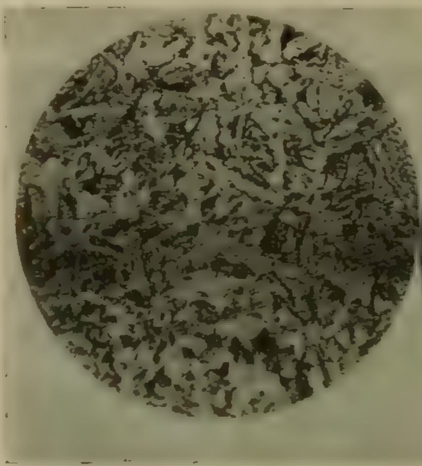


Fig. 12.

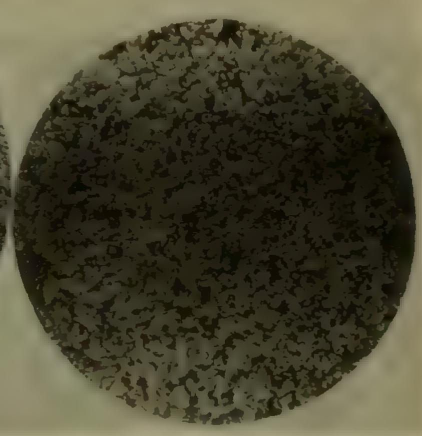


Fig. 13.

there is no way from the test or analysis of ascertaining the proportion of steel entering into the mixture.

Where still additional strength is required and a considerable toughness, the malleable casting offers an excellent solution, especially where the castings are small. The malleable casting should not be confused in value with steel forgings as the only part that is at all ductile is the outside skin. Malleable castings are of about twice the value of grey iron castings.

Where combined strength and ductility are required, the steel casting is the only form that can be used where a cast shape is necessary. One of the great objections to steel castings is the danger of superficial blow-holes, so that where a clean finished surface is required it is well to substitute some other form of casting, unless sufficient confidence can be placed in the foundryman to furnish the proper material. There is no question but that castings can be made free from blow-holes if proper precautions are taken and it has been my personal observation that both vanadium and titanium treated steels have been in every way satisfactory for castings. Not only have the steels been free from blow holes but they have been rendered much denser by the expulsion of the occluded gases.

In this connection it might be well to consider the subject of the proper design of castings and give a few principles which may not be generally understood. Castings should, if possible be of uniform cross section with the corners well rounded and generous fillets in the angles. This is especially true in steel castings where the shrinkage is large. When iron and steel solidifies, the crystals forming tend to set themselves normal to the surface, consequently when the corners are square, a plane of weakness is formed, the plane bi-secting the angle at the corner.

In forgings and bar material the engineer has a wider range to select from and after the analysis of his condition can select that which will in nearly every way comply with his requirements. The cheapest material that will satisfy this condition should be selected, but it should not be overlooked that a more expensive material of higher value reduced in size may be the cheaper and more satisfactory. Before considering this matter in detail it would be well to discuss the relative values of the various classes of forgings and bar stocks.

The value of the hammer forging is in the mechanical refining which takes place throughout the entire mass due to the equal hammering of the forging.

In the drop forging the hammer tends to hammer one part of the forging much greater than other parts, resulting in unequal stresses which tend to either weaken the material or cause a subsequent distortion. With the proper heat treatment a drop forging will be of equal value to the hammer forging, provided it has had care in heating for the forging operation. Unfortunately there is a tendency to overheat the steel to have it conform readily to the shape of the die and to reduce the work, involved in forging, to a minimum. This is of course a great mistake and constitutes the chief objection to drop forgings. There is one point in drop forging that should not be overlooked, namely, that all drop forgings subjected to any very considerable stress should be either annealed or heat treated before being used. This is very imperative with gears where they are to be subsequently hardened or tempered, and it should be done prior to the machining operation, so that the distortion resulting from the annealing operation may be machined out.

Fig. 12 indicates the structure of 3½ per cent nickel steel in the normal forging. Fig. 13 shows the same steel properly annealed.

Bar stock is one of the best forms in which to receive material. If properly handled at the mill it should possess the best properties obtainable by mechanical refining.

For a matter of strength only under static loading, carbon steel of the lowest carbon content to meet the requirements can be selected. Where limited to size or weight, a selection must be made either in the carbon steels heat treated, or the alloy steels, and they should be treated in the lower ranges of the temperature scale.

When a certain ductility or hardness is required this must be taken into consideration. Nickel steel especially possesses strength with ductility. This combination requires treatment in the medium ranges of the temperature scale, or toughened.

For high ductility the lower steels untreated or the higher steels treated in the high ranges of the scale should be selected. Extremely ductile steels show the least strength. Carbon steels, and those containing nickel treated, show the greatest ductility.

Case carbonizing gives the greatest hardness consistent with toughness. The material for the case may be selected to suit the need for strength or toughness. When moderate hardness combined with strength are required, the high steels containing chromium should be selected. This is especially desirable when limiting conditions of size or weight exist. It is impossible to get the hardness of case carbonized material with toughness in steels of this kind.

The selection of structural steel is comparatively simple. There seems to have been a tendency to increase the strength by increasing the carbon and manganese, but this is hazardous in the face of possible dynamic stress, and it is much better to use a little extra material and keep the carbon content in the medium range.

Some engineers base their factor of safety on the ultimate strength, but this should not be done. The elastic limit should be considered the real measure of strength of any steel.

Nickel steel of above 0.25 per cent carbon is becoming popular for structural purposes. This steel has a value of from 15,000 to 20,000 pounds unit value over carbon steel of a similar composition. There is little question but that eventually it will be common practice to heat treat structural steel.

It has been the author's endeavor to treat this subject in such a way as to present the general principles involved. This manner of treatment will probably be of the greatest benefit to the many.

MENDING MALLEABLE CASTINGS by the following method is suggested in the *Iron Age:* The fracture is chipped away in the form of a V-groove, and the part surrounding the fracture is then heated with an oxy-acetylene torch to a bright red and sprinkled with a bronze flux, followed by a few drops of Tobin bronze melted from the welding-rod. If the bronze remains in a little globule, the work is not hot enough; but if it spreads and adheres to the surface, the temperature is right, and the groove should be quickly filled, and at as low a temperature as possible.

MAINTENANCE AND CARE OF LOCOMOTIVE BOILERS.*

By J. F. Raps, Genl. Boiler Ins., Ill. Cent. R. R.

As we are on the verge of another winter, it might not be amiss at this time to take up the maintenance and care of the locomotive boilers, as during this season of the year the number of engine failures due to no steam and flues leaking is greatly increased. They are aggravated by three distinct causes, namely: improper work at the round-house, improper firing and improper handling of the feed water.

In these days of long hauls, increased tonnage and high speed, the locomotive boiler is a very important item in railroad economy, and there is no part of the locomotive which requires more careful and painstaking care than the boiler. Each one, from the engineer to the cinder-pit man, should contribute his share toward keeping it in a serviceable condition and in the highest state of efficiency and this can only be accomplished by the hearty cooperation of all concerned with the handling and operating of the locomotive.

Let us first deal with the shop organization, as a great deal depends upon the proper method of handling the work on running repairs. After the locomotive has been turned out of the shop and before being placed into active service, the roundhouse inspectors should make a thorough inspection of the front end appliances, ash pan and grates, in order to ascertain if they have been properly applied and are in perfect condition. This is very essential in order to avoid engine failures, due to being improperly drafted or having some defect develop in the newly applied front end rigging or grates, but more especially to overcome the setting of fires on bridges or along the right of way. A like inspection should be made after each trip and a report made on regular form showing condition. Any defect reported should be repaired immediately.

The cleaning of flues is a very important factor in locomotive performance, as stopped-up flues will cause a poor steaming engine. Whenever an engineer reports steam pipes leaking, engine not steaming or hot at door, examine the flues first to make sure that they are clean, as invariably the above conditions are due to stopped-up flues. The proper method of cleaning flues is with the auger and compressed air. Flues should be thoroughly blown out with air at the termination of each trip. When flues are stopped up they should be bored with an auger of sufficient length to reach from end to end and then blown out thoroughly with air. Special attention should be given flues in superheated locomotives. In locomotives with brick arches the bottom flues must be maintained in clean condition and no locomotive should be allowed to go into service with any flues stopped up. This work should be done previous to boilermakers entering the fire box in order that they may check the work to see that it has been properly performed.

The brick arch, which has gained such a prominent part in the economical operation of the locomotive, should receive a great deal of care and consideration. By its use the trouble experienced by leaky flues is very materially decreased and their life greatly increased. Care should be taken to see that the arch is properly cleaned off after each trip and is maintained in perfect condition. The engine should not be allowed to go into service with holes in the arch or with part of the arch missing, as trouble is likely to be experienced either with the flues leaking or a poor steaming engine.

The work on flues on running repairs should be performed in the following manner: Flues showing cinder-pit leak, to be caulked by hand with standard beading tool. Flues blowing or leaking enough to allow water to run down sheet, should be expanded with a straight sectional expander; the use of the roller is not permissible. Special attention should be given to flues when the boiler is washed out. All leaks should be stopped with a sectional expander while the boiler is hot and a "V" of flues in lower part of sheet should be beaded with a light air hammer and the standard beading tool, while the boiler is empty. The flues should be inspected after the boiler is refilled and any leaks tightened up.

*From the *Illinois Central Magazine.*

This is especially important, because the inequalities in temperature occasioned by the cooling and washing have a tendency to break the joint of the flues in the flue sheet.

Now we are about to take up one of the most important operations performed at the roundhouse—the washing of the boiler. This subject is so extensive and the methods used so conducive of good or bad results that I will give a few concise rules governing the proper method of preparing and washing the boiler.

1. Locomotive boilers are required to be washed as often as may be necessary to keep them clean and free from scale and sediment.

2. Boilers should be thoroughly cooled before being washed at all points excepting where improved hot water washing systems are installed.

3. When there is sufficient steam pressure to work it, start the injector and fill the boiler with water until the steam pressure will no longer work the injector. Then connect water hose to feed pipe and fill boiler full, allowing the remaining steam pressure to blow through syphon cock or some other outlet at top of the boiler. Open blow-off cock and allow water to escape, but not faster than it is forced in through the check, so as to keep the boiler completely filled until the temperature of the steel in the fire box is reduced to about ninety degrees, then open all blow-off cocks and allow boiler to empty itself as quickly as possible.

4. While the boiler is cooling the boiler washer is to loosen all wash-out plugs. All wash-out plugs and arch tube plugs must be removed at every washing.

5. Removing the plugs or opening the blow-off cocks is forbidden until the water coming from the boiler is cooled to 90 degrees. The object of this method is to cool the boiler equally.

6. The crown sheet shall then be washed, starting on sides and then washing through holes in backhead.

7. The door ring to be washed next.

8. Wash arch tubes next. It is very essential that the pneumatic or other cleaner be used every time boiler is washed and all concerned are instructed to strictly comply with these instructions.

9. Then wash through plug holes in barrel or boiler just ahead of firebox, using bent nozzle in order to thoroughly wash down flues. Wash flues through plug holes at front of barrel, using bent nozzle.

10. Wash belly of boiler, starting at front end, using bent nozzle, washing scale toward firebox.

11. Wash legs of boiler through plug holes in side and corner of firebox, using straight nozzle in corner holes and bent nozzle through side holes, revolving same to clean the side sheets. Rods to be used to dislodge any accumulation that water pressure will not move.

12. After boiler is washed out it should be thoroughly inspected through all plug holes before plugs are replaced, to see that no accumulation is left. The work of inspecting should be taken care of by foreman boiler maker or inspector.

13. The removal of all plugs is imperative. The plugs should be put back with a coating of graphite and oil made to a paste. This enables the plugs to be removed readily.

14. Boilers should be washed out with a minimum of 100 pounds pressure.

It must be remembered by those in charge that, when orders are issued to boiler washers to slight the washing of any boiler in order to get the locomotive ready for a certain run, they are storing up trouble for the future. Although it might not be in evidence at that time, the day of reckoning is sure to some. Blowing-out can be resorted to in some instances to save washouts, with either incrusting or alkali water, but care must be taken to see that the fire is in proper condition, that is, clean and bright.

The prevention of engine failures due to leaky flues does not rest entirely with the roundhouse boilermakers, regardless of the fact that they are compelled to assume the responsibility in most instances. One may take a locomotive with practically a new set of flues, and by the improper use of the injector, cause most of the flues to leak. This can be demonstrated by getting into the firebox after the fire has been drawn and the locomotive placed in the roundhouse with a perfectly dry set of flues, then start either the right or left injector and watch the result caused by the change in temperature of the water around the flues. The engineer and fireman should carefully examine the fire box sheets and flues as soon as they take charge of the locomotive, reporting any leaks or defects to the roundhouse foreman.

If the flues are all open, in good condition, and there is no mud on the flue-sheets, there is absolutely no reason for a failure due to flues leaking, yet there are cases where tonnage is reduced or trains set out, and on making an inspection of the flues, they are found to be in good condition, but loose in the sheet, which is prima facie evidence of the improper use of the injector.

After the cause and effect of the inequalities of temperature in the boiler is thoroughly understood by the enginemen and hostlers, it should not be difficult for them to fully appreciate the damage done to the flues and fire box sheets by the injection of water at a temperature of about 200 degrees lower than the water in the boiler. It is a common practice to fill the boiler at terminals while the blower is on and the fire door standing open, in order to eliminate the black smoke. Whenever it becomes necessary to fill the boilers while standing at stations or on sidings, a bright fire should be maintained, using the blower and applying fresh coal if necessary. The fire door should be closed while the injector is working. It is not desirable to put a large amount of water in the boiler at one time, unless it is necessary in order to protect the crown sheet. Enginemen should endeavor to leave their locomotives at the cinder pit with a full boiler of water and a good fire in order that the hostlers will not be required to fill the boiler just previous to blowing off. Care should be exercised by the hostlers in blowing off and in no instance should the boiler be blown off when the fire is dirty, and too much water should not be blown out at one time. In no case should the water be reduced over one gauge. Hostlers should see that there is plenty of water in the boiler to allow for refiring, before knocking the fire, as it is very poor policy to put water into the boiler while cleaning or knocking the fire. Care should also be taken to see that the fire is clean and in good condition in locomotives that it is necessary to herd on account of short lay-over or shortage of roundhouse room.

The successful maintenance of the locomotive boiler in service is summed up in just one word, "Co-operation." First, by the foreman and mechanics turning out a perfectly tight boiler from the locomotive works or the company shop. Second, the careful inspection and work of the roundhouse organization in keeping boiler tight and free from mud and scale. Third, in the careful handling by the enginemen. The best care and workmanship will be of no avail, however, if the boiler does not receive intelligent treatment while in service.

LET US SMILE.

The thing that goes the farthest towards making life worth while,
That costs the least and does the most is just a pleasant smile.
The smile that bubbles from a heart that loves its fellowmen
Will drive away the cloud of gloom and coax the sun again.
It's full of worth and goodness, too, with manly kindness blent—
It's worth a million dollars, and doesn't cost a cent.

—*The Little Blue Flag.*

THE NATIONAL COUNCIL for Industrial Safety held its third annual safety congress at the Hotel LaSalle, Chicago, Ill., on October 13, 14 and 15, 1914. On October 15 an address on the "Safety Problem of the Railroads" was given by W. B. Spaulding, chairman central safety committee, St. Louis & San Francisco R. R. R. H. Newbern, Pennsylvania R. R.; M. A. Dow, New York Central Lines, and E. L. Tinker, El Paso & Southwestern system, took part in the discussion of the subject.

The Master Boiler Makers' Association will hold its ninth annual convention at Chicago, Ill., on May 24, 1915.

The American Association of General Baggage Agents will hold its next convention at Los Angeles, Cal., on May 12, 1915.

CLASSIFICATION YARD LIGHTING.

An interesting discussion of the lighting of railroad yards is given in a paper recently presented by Messrs. H. Kirschberg and A. C. Cotton, on "Railroad Illuminating Engineering —Track, Scale and Yard Lighting," before the Pittsburgh section of the Illuminating Engineering Society.

The authors state that the freight haulage capacity of a road is as dependent on the scale and yard capacity as it is on motive power equipment, and that a congestion in the yards will reduce the earning power just as effectively as the disablement of a locomotive or other rolling stock.

The lighting of an area, such as is presented by this class of yard, affords some unique problems, the successful solution of which greatly facilitates the movement of freight traffic. The yard is not to be considered as an open area, but, in reality, as a series of streets three or four feet wide, with buildings (freight cars) about fourteen feet high on both sides.

One of the most effective installations of lighting in a classification yard recently made is that of the Pittsburgh & Lake Erie Railroad at McKees Rocks, just outside the city limits of Pittsburgh, Pa. This yard contains about twenty racks, extending for approximately one-half mile.

The source of light is the Cooper Hewitt quartz lamp, mounted on steel towers, as shown in the accompanying illustration. The installation consists of eight units, the lamps being rated at 2,400 candlepower, with an energy consumption of 726 watts, resulting in an efficiency of .3 watt per candle. Direct current at 220 volts is supplied to the lamps from the power plant of the company located nearby.

The towers, which are twelve feet square at the base, are 100 feet high and are spaced about 400 feet, in two rows, one on each side of the yard, or approximately 225 feet across. The lamp is suspended from a short mast arm, which extends out over a platform for the attendant, access to which is had by means of a ladder mounted on the side of the tower.

A chain and cut-out, however, permit the lamp to be lowered from the ground, thus obviating the necessity of the lamp attendant climbing the tower.

As the quartz burners have a life of several thousand hours, and the globes are at such a height as to be out of the smoke zone, almost no cleaning or other attention is required.

The ideal condition of illumination of the yard is, of course, to make it as light by night as by day, so that the riders, when directing the cars to their proper spaces in the yard, may be able to see clearly the location of other cars and thus prevent them from excessive "bumping."

The illumination of the McKees Rocks yards, which has been installed under the direction of D. P. Morrison, electrical engineer of the Pittsburgh & Lake Erie Railroad, very nearly approaches this ideal condition.

The light given by the lamps spaced as they are completely floods the yards, enabling the men to see with proper clearness, not only every track and car but also the switches at the head of the yard. The illumination is such that one may readily read a newspaper at night. The entire absence of shadows and glare greatly facilitates the movement of the cars throughout the yard, by permitting the exact location of each to be easily determined, and also greatly adds to the safety of the men and tends to prevent accidents.

Possibly the best commendation given the efficiency of the installation is the statement made by one of the railroad officials that "the yard men never lose any chance to praise it." Considering the well known reluctance of the average individual to praise his working conditions, this statement is peculiarly significant.

In addition to the increased speed in handling cars gained through the better lighting, conditions are made much easier for the men returning on foot to the head of the yard, as when the yard is poorly lighted it is difficult for them to avoid incoming cars, switches, posts and other obstacles, and the Pittsburgh & Lake Erie employees are particularly pleased with this feature.

The fact that the lamps are mounted at such a height permits an excellent distribution of the light which possesses an inherent color value that is particularly suitable for outdoor illumination. Another feature that peculiarly adapts the quartz lamp to this field of lighting is the steadiness of the light.

The International Railway General Foremen's Association will hold its eleventh annual convention at the Hotel Sherman, Chicago, Ill., on July 13, 14, 15 and 16, 1915.

Classification Yard of P. & L. E. at McKees Rocks, Showing Lighting Towers.

INTERCHANGE OF CARS.*

By H. Boutet, Chief Interchange Inspector, Cincinnati, O.

The subject of interchange of cars has given the majority of you a great deal of concern, as it is a matter of importance to all persons engaged in the operation of any railroad in this country.

You must all realize that it is of very little use to receive a car of freight at one point, haul it out the line and then have it refused by some other line, as the railroad has not completed its service until it has delivered the car to connecting line or to its destination.

In the efforts of the railroads to increase their efficiency to meet the ever increasing demands of the transportation business, the interchange of cars is one of the matters that is today occupying the attention of the transportation and mechanical officials, the Interstate people, and the shippers, for they are vitally interested.

While considerable has been accomplished in the improvement in the getting of cars through the terminals, much is yet to be accomplished. A great deal more could be done when cars are empty by having all of them put in such a condition that they are safe to haul the commodities they are built to carry, or at least such commodities as originate on your line, to any destination within reason.

Make it the duty of some person to see that your inspectors do not allow any cars to get out on your line that are not in good condition, and see that all agents along your line have a good general knowledge of a car and the M. C. B. rules, more especially the loading rules. This will save a great many transfer orders being given against your line, which cost money, not only in the cost of the transfer of the cars, but in the number of claims that are made by the shipper, when he finds that his shipment has been transferred. It will also get the shipment to its destination in much less time.

The matter of claims seems to have been overlooked by a great many persons, but I assure you that it is a matter that is costing the railroads vast sums of money every year. What is the company's interest is our interest, and if we would all follow these rules it will be a great benefit to interchange. We have been passing from one condition to another in the car department so rapidly that it is going to take several years to overcome the difficulties that we are experiencing now.

In my early days of car construction we would construct a draft arm of 3½" by 3½" timber, while now it is almost impossible to get a stick of timber large enough (considering space) that will stand the shock which cars are now subjected to. This is only an example to compare the car construction of today with that of previous years. This condition has been brought about by the heavy motive power and heavy car equipment that the railroads have been compelled to adopt to transport the commodities of the country and to meet obligations, caused by the increase of salaries of the employees and the legal restrictions laid upon them by the local and federal authorities. This, in a few years, will be overcome when all of the railroads of the country are able to replace their wooden cars with steel equipment of sufficient strength to withstand the strain put upon them.

Any railroad official will tell you that they are interchanging cars in accordance with the M. C. B. Rules, or in other words, they will tell you that they want to live strictly up to the M. C. B. Rules.

It appears that the M. C. B. Rules have as many interpretations as the father will have excuses for taking his hopefuls to the circus, and we all know that there are many. Still each person will claim that his interpretation is the only correct one, and I have no doubt that some of you will say this is wrong; that there can be only one interpretation to any one rule.

Unfortunately there never has been any rules or laws so plain but what somebody can and will misunderstand them or see something in them that another fellow does not see. Sometimes this is an honest difference of opinion and sometimes it seems that it is a notion taken with the view to see how different they can be from other people. Again it seems that the lenses in our eyes are made so that we cannot see but one side or what is to the advantage of our road on any particular case.

You may take a case out on your line, where there are two interpreters; one inspector working for your line and one representing the other line. The inspectors have gotten into a disagreement regarding the condition of a car. The car foreman will go to that point and ask his inspector what the trouble is and the inspector will tell his foreman that the car has three broken sills. The foreman will examine the car and find three of the sills with a crack from one-half inch to one inch at or near the transom and he will tell his inspector that these are not bad enough for repairs.

His inspector's answer to this will be that he has been compelled to card for such defects as these all the time since the present rules were in force and the other inspector's foreman upholds his inspector in setting out such cars, which they will not accept without a defect card.

The foreman will take the side of his inspector and tell his master mechanic that the car should be carded and that the defects are of such a nature that they have been carding for all of the time. Finally the case is settled by the other fellow carding the car, after the car has been delayed some three or four weeks. This, of course, makes the inspector of the delivering line mad and causes him to become more technical in his inspection to enable him to get even with the other line, while the inspector who will gain his point, sticks a feather in his hat and goes around and says, "I told you so."

Now this is bad for efficiency, it causes delay, and delay to cars is the worst enemy the transportation department has to fight. Some people will tell you that, according to M. C. B. Rules, it is necessary for the delivering line to inspect and set out all cars for repairs or transfer and card for delivering line defects that are safe to run before the cars are delivered.

Others will tell you that you must set all of your cars for interchange on a certain delivery track, where the cars will be inspected by the receiving line. After inspection the delivering line must come back and take out all of the cars for repair or transfer, take the cars marked shop to the shop and put defect cards on all cars that are required. Others will tell you that what is known as "twentieth century inspection" is M. C. B. Rules.

Now let us see if we cannot get at a common understanding of this particular matter and avoid confusion by seeing what the rules say. The preface of M. C. B. Rules says in substance that car owners are responsible for ordinary wear and tear in fair service and railroads handling the cars are responsible for damage done to cars by unfair usage, derailment, accident, etc. The rules then go to define a large number of defects in accordance with the preface.

M. C. B. Rules are given us as a basis on which to work. The writer takes the stand that it does not matter where a car is inspected, whether in the delivering or receiving line's yard, as may be agreed upon by the roads interested. Sometimes local conditions determine this question so there can be no hard and fast rule about that. It is understood that the delivering line is held responsible for any damage that may have been caused to cars by unfair usage, derailment or accident, or any missing material that cannot be charged to the owners of cars in interchange.

Let us take the situation at Cincinnati. The majority of interchange is made through switching lines or through two or three yards by the delivering line, the distance between some of the delivering line and receiving line yards being twenty-six miles.

There are several methods by which inspection and interchange could be made, all of which the writer claims is within scope of M. C. B. Rules.

First. It could be made by the receiving lines putting their inspectors in the delivering line's yard and after the cars are side carded, inspecting and marking out such cars that they want repaired, transferred or carded. Cars passing the inspectors as

* A paper delivered before the Southern and Southwestern Railway Club.

O. K. for service could be switched out and delivered to the receiving line.

Second. Cars could be inspected by the delivering line's inspectors and cars that they think should be repaired or transferred and defects that they think should be cared for, should be carded and delivered to the receiving line.

Third. The inspectors could be placed under the chief interchange inspector and cars inspected in the delivering line yard. Cars that are required to be set out could be marked out, those requiring repairs could be repaired, those requiring transfer could be transferred and those requiring cards could be carded.

Fourth. Cars could be given a safety inspection in the delivering line yard by the delivering line's inspectors to see that the cars are safe to go to the repair or transfer track of the receiving line. When they are delivered in the receiving line's yard they could be inspected by the receiving line's inspectors. Cars that require repairs or transfer are set out for necessary work and the cars requiring cards could be carded.

Now let us see the advantages and disadvantages of these different plans.

First system. It would be necessary for the lines to have twice as many inspectors or more than would be required under the other plans, as no road would agree to have a car inspected in a foreign yard and then switched and handled by a foreign road, without again being inspected when received in their yard.

You would have the advantage of having all bad order cars set out in the delivering line yard, consequently, you would only receive good cars or only such bad cars as were made such after inspection.

Again, it should be taken into account that no inspector would take any responsibility if he was placed in the delivering line yard and if there was any question at all he would set the car out. His foreman would not take any great exceptions to this, for if the delivering line foreman would come to him and tell him that his inspectors were too close, the only answer he would get would be that "they were not any closer than your inspectors, for your inspectors are doing the same in my yard, and when you have your inspectors set out only such cars as should be set out, I will have my inspectors do the same thing." The consequence would be, if you did not have a chief interchange inspector or assistants located in each yard both day and night, your line would be blocked in twenty-four hours with cars that the receiving line's inspectors had set out for repairs or transfer, when in fact a great number of them should not have been set out, but should have been on their way to destination.

You have delayed freight, caused extra switching and consequently created additional expense, and also created a feeling with the shipper that you had not attempted to give him the proper service.

Second system. It has never been found that the delivering line will inspect and card all cars that the receiving line wants carded, or set out all cars that the receiving line thinks should be set out, either for transfer or repairs, nor will they card all cars for defects that the receiving line wants carded. This system has been tried at every large interchange point in the country and has never proved satisfactory.

You have all of the work to do over, as you are not satisfied that the other fellow has given you all that you should have had and as you have to answer for the safety of equipment going over your line, you want to know positively that it meets all requirements and will have your own men inspect the cars as they come to you.

Third system. This does not always prove satisfactory, as the men you employ are under another man's jurisdiction and supervision and you are not always able to get results that you require. The instructions that you require for your particular line are not always carried out in the manner you desire, as the instructions issued to inspectors are of a general nature and about on a par with what all the roads require. In this way you have your work to do over for about the same reasons as given in the second system.

Fourth system. This has some disadvantages, but in the writer's opinion has a great many advantages over all of the other systems.

You have the disadvantage of bad order cars to your line either for repairs or transfer, which is offset by the cars in the same condition going from your line to the other line.

The advantages are numerous.

You have the advantage of having your own inspectors in your own yard directly under your own supervision and you can require them to use their judgment, according to the instructions given by you in the marking out of the cars for repairs or transfer.

Every car that they mark out is brought to the immediate attention of the car foreman and for every car marked out that should not be marked out, you have the remedy which you can apply directly. The consequence is that they do not mark any cars out that you do not want marked out and in this manner save a lot of switching and confusion.

Again, if a car should have a cotter key out or a bey bolt or other slight repairs which the inspectors could not make in less time than they could mark the cars out, you will have them make these repairs, but if the car was in the other person's yard the inspector would make the claim that he was sent there to inspect cars and not repair them.

The fourth manner, as described above, is the way that the interchange is done at Cincinnati, as it is believed to have accomplished the best results. It keeps the cars moving with little loss of time and does not set out cars that do not require setting out, only setting out such cars that are liable to cause damage. The inspectors in the receiving line yard card for all defects on cars that they do not wish set out.

The assistant chief interchange inspector visits each yard each day, carding all cars set out for repairs, combinations and heavy defects.

This manner of carding has been in effect a little over two years and while there have been some cases in which the inspectors have been wrong, where we have been compelled to give rebuttal cards to straighten the trouble, I have the first case to find where the inspector wilfully misused the cards.

There is no set back of cars for bad condition, except through instructions of the chief interchange inspector, which consequently put the set back cars at a minimum.

This manner of interchange is believed by the writer to be the best system of interchange in the country today, as there is less friction and contentions than we have ever had with any other system that has been tried at this point. I believe that it compares favorably with any other large interchange point in the country and it does not deviate from the principles as laid down by the M. C. B. Rules.

I will now bring out a few points with regard to "twentieth century inspection," as it is known and handled by us at Cincinnati. A train of cars will come in on one road, and, when they are side-carded, the inspector goes over them. If the cars are for connections, he will inspect those cars to see that they are safe to go to the repair or transfer track, and then will let the cars go. Some of our interchange is over roads with very heavy pulls, and they have to be pretty careful with the cars that are safe to go over. When the cars reach the receiving line's yard, they are inspected by the receiving line's inspectors. As I stated, he does not set out the number of cars that he would if he was in the other fellow's yard, for his foreman is directly after him, and as soon as he sets out a car, that should not be set out, he gets after him to know why he didn't let that car go on. On the other hand, under the other systems, if he was in the delivering line's yard, he is going to keep any censure from himself. Consequently he will set out anything the least bit suspicious to him. He delays the cars, because they have to be switched out over there, and possibly some little thing amounting to ten cents has to be done. We avoid all of that under the "twentieth century inspection." I have never found a case in the little over two years that it has been handled that way, where the inspector misused a card, or put on the card where it should not exist.

We invite the foreman to come over there, and we don't have much of that kind of business to report, because they are in the man's own yard, and under his own supervision, consequently there is no occasion for him to find fault, except to attend to the defect card. I have found some cases where the inspectors were in error, and I have given rebuttal cards to straighten the matter up.

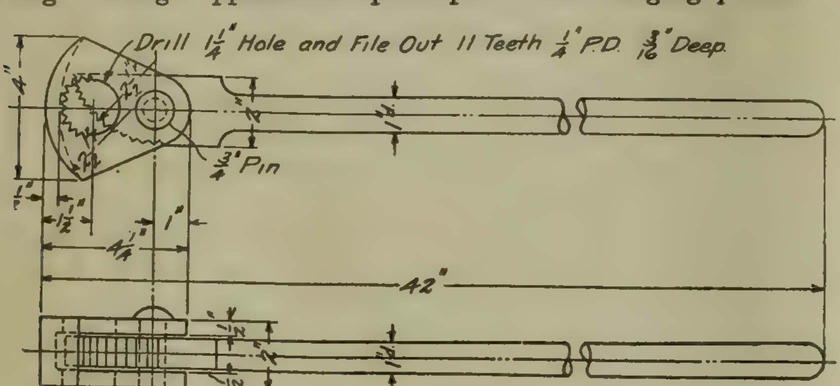
If a car wants a cotter key, or something like that, they usually don't mark the car up. If it was in the other fellow's yard, he would set it out. Again, it keeps the inspectors working, and only in such numbers as are actually required to do the work. We avoid the necessity of having double the number of inspectors, consequently a good deal of idle time is saved, which is always likely to breed trouble. We have found that in some cases, where a surplus number of inspectors get together, they bring up points, and are always stirring up trouble.

At first, they would not open box lids to search them. They would say "we are only inspecting the cars, not the inside parts or concealed parts." They would not put a cotter key in, or anything like that, but, when they have inspectors in their own yard, they will do what the company wants them to do. There are agreements with some of the companies down there that inspectors only have to do certain duties, but there's a way to get around the most of them. There's usually somebody else to put in his place, if he is arbitrary. We find them trying to help the matter along. We have tried to take it to the employees of the railroad that, as an employee, his duties go further than his particular work, if he has got time to do it, and that these little things can be done in much less time than it would take to make an entry on the book and mark the car out. They figure up there that it costs about $2.00 a car to switch a car out and get it in service again. That's not on the mechanical department; it puts it on the transportation department, but the money comes out of the same pocket.

We have tried to get away from this departmentizing so much, and tried to get them to realize that what's to the departments interest is to the company's interest, and that, if a man in the mechanical department can save the transportation department $2.00, it is his place to do it.

STUD WRENCH.

The accompanying illustration shows a stud wrench that has been made a standard for use in Canadian Northern shops all over the system. It is made of tool steel, and is used for applying and removing stud bolts. A 1½-inch hole is drilled in the center of the hinged portion, and 11 teeth, 3/16 inch deep, are filed out along the edge opposite the pivot pin. The swinging portion is



Wrench for Applying or Removing Studbolts.

slotted to receive the lever, which also has 16 teeth to correspond. Both sets of teeth are case-hardened.

The teeth of the swinging portion are on a cam section, so that by bringing forward the handle, the full 1½-inch hole is open, and the wrench may be slipped over the projecting stud. Swinging the handle in the opposite direction causes the cam teeth to grip the stud, forcing it against the stud in the other portion, gripping the stud securely. The wrench may be swung back and forth in applying or removing, the same as a stillson wrench, but has the advantage of not slipping off the stud, and in consequence may be operated much more rapidly.—*Canadian Railway & Marine World.*

CAR FOREMEN'S ASSOCIATION.

That live and growing organization, the Car Foremen's Association of Chicago, held its annual meeting at the Drill Hall, Masonic Temple, Chicago, on Tuesday evening, October 13. As this evening is always devoted to an entertainment for members and their families, there was a large attendance which necessitated the use of the banquet hall on the nineteenth floor also. At the business meeting, held early in the evening, the secretary reported that 498 new members had been received during the past year and applications of 44 new members had been received that evening. The following new officers were elected: President, C. J. Wymer, general foreman, Belt Ry.; 1st vice-president, A. La Mar, master mechanic, Pennsylvania R. R.; 2nd vice-president, A. L. Beardsley, master mechanic, Atchison, Topeka & Santa Fe Ry.; treasurer, M. F. Covert, assistant master car builder, Swift & Co.: secretary, Aaron Kline, 841 No. Lawler avenue, Chicago.

An extract from the address of the new president, C. J. Wymer, states very well the history and purpose of this organization.

"At a meeting held in Chicago, October 6, 1897, among a few local car foremen, it was decided to create a permanent organization, the object being 'the discussion of subjects of common interest to those engaged in the repair and interchange of cars'. It resulted in the Car Foremen's Association of Chicago being organized and legally incorporated under the laws of the State of Illinois with a charter membership of nine members, three of whom have served this association as president and all have contributed largely to its success.

"The membership of this association is composed largely of men who are constantly on the firing line and our meetings have been confined almost exclusively to the discussion of subjects of peculiar interest to them, and to this particular feature of our policy we attribute the marvelous success of our organization. We meet on equal terms, discuss our problems in an unvarnished way, good fellowship is promoted, our knowledge increased and we go back to our tasks with greater respect for our occupation, with a broader view of our problems and make more useful employes for the companies we represent.

"The car department is an important factor in the railroad service and its importance is more and more recognized each succeeding year. Our duties are being enlarged upon and we are increasing our usefulness, and we feel that we should encourage, rather than discourage, the acceptance of added responsibilities, as it can only mean growing recognition and better opportunities for our men.

"When we consider the responsibilities entrusted to car foremen and car inspectors especially, we must recognize in a competent man more than average intelligence and judgment. The safety of the traveling public, the safe transportation of commerce, is entrusted to their judgment; therefore, we should recognize our responsibilities fully and give the best service we possibly can. It is a duty we owe to our companies, ourselves, our families and to the public at large."

During the evening the past presidents were brought to the platform and after the new officers had been called upon, Mr. Wymer, with a few apt words, which were happily chosen, presented each of the past presidents with a gold badge.

The following are the past presidents of the association: T. B. Hunt, T. R. Morris, W. E. Sharp, J. C. Grieb, Le Grand Parish, Henry La Rue, C. R. Powell, I. S. Downing, O. M. Stimson, T. H. Goodnow, Peter Peck, W. O. Davies, W. B. Hall, George Thomson, F. C. Schultz and George F. Laughlin.

The orchestra played many popular songs and afterwards furnished music for the dancing. A buffet luncheon was also served and special entertainers furnished amusement for what proved to be a highly successful evening.

The American Association of Passenger Traffic Officers will hold its next meeting at San Francisco, Cal., on March 2 and 3, 1915.

Officers of the Car Foreman's Association

C. J. Wymer, Gen'l Fmn., Belt Ry.;
President.

A. La Mar, M. M., Penn. R. R.;
1st Vice President.

Aaron Kline, Secretary.

A. L. Beardsley, M. M., A. T. & S. F. Ry.;
2nd Vice President.

M. F. Covert, A. M. C. B., Swift's Car Line;
Treasurer.

ELECTRIC HEADLIGHTS.*

During the last two years more locomotive headlights have been installed than in all the previous years of electric headlights. Most of these equipments were installed in compliance with the laws of various states. As the interpretation of these laws has caused quite a difference of opinion, it was only natural that the installations were not made until near the expiration of the time set by the law. This resulted in the equipment being installed in a somewhat haphazard manner, by inexperienced men, and lack of uniform methods.

Very few of the railroads today have adopted a standard wiring system, and where such systems have been adopted, they have not been lived up to. Many railroads are now trying to standardize wiring and equipment, however.

For many years a series type of generator has been in use, and it was generally conceded to be the only practical machine. In the last two years all manufacturers of headlight equipment have standardized on a compound wound machine. While both types have their advantages and disadvantages, the majority of the equipments sold today are of the compound wound type.

Three voltages are in use, namely, 6 volt for incandescent lamp machines, and 30 volt and 110 volt machines for arc or incancandescent. The 6 volt machine has not found favor on account of the constant attention necessary to the commutator and the many cases where these low voltage generators will not pick up.

The 30 volt machine is undoubtedly the best voltage for arc lighting, but at the present time, it has not been possible to manufacture an incandescent lamp for this voltage that is durable.

The 110 volt machines have been used by few railroads and for headlight work do not seem practical.

The location of the generator on the engine has caused considerable worry to most mechanical departments, and there is a wide difference of opinion at the present time. Where possible, it seems most practical to locate the generator directly in front of the cab.

To determine the voltage of the generator seems to be one of the hard problems to solve. With the compound wound machine there is usually about 1½ volts drop in the series field coil and practically the same drop in the engine wiring. Determining the voltage by the speed of the turbine has long been the practice, but the advent of high speed machines has caused the speed indicator to give very inaccurate results. Then, too, all machines will not give the same voltage at the same speed. On account of the fragile construction of a voltmeter, their use could not be encouraged for roundhouse employees. The committee believes that the average headlight man can judge from the candlepower of the lights in the cab without the arc burning whether the generator is giving the correct voltage or not. This method requires much less time and has worked out well on many roads.

The committee would recommend that a standard candle power and voltage for cab lamps be adopted. It has been found that the voltage of compound wound generators of the 30 volt type has a variation in the cab of from 5 to 10 volts, from when the arc load is on to when only the cab lights are burning. This makes it necessary for the cab lamps to be capable of standing about five volts more than the working voltage of the generator with the arc load. At the present time, lamp voltages run from 28 to 40 volts used with 30 volt machines. The result has been that the lamp manufacturers have not carried a standard headlight lamp and the cost to the railroads have been proportionately higher.

Many of the railroads in equipping their engines with headlights have built over the old headlight cases used for oil, using the shallow reflectors. While this seemed to be a necessary expedient at that time, an effort should be made to purchase 18x 10½ in. reflectors, as the old reflectors are generally worn out. It is hard to get a perfect beam of light with these shallow reflectors.

Few roads agree on a uniform system for wiring engines. Some have blue prints showing their wiring standards and list of materials. Wiring in the hand rail has many disadvantages and usually costs more than a separate conduit. Nevertheless the majority of the railroads today are wiring their engines through the hand rail.

Using a 1 in. conduit with condulets at outlets with a special connection box on the cab, so that the cab or conduit can be removed without interfering with the wires, offers the best solution of this wiring problem. The cost of such a system will be less than one using armored conductors, and where it is necessary to take down the hand rail and drill for wires, will be cheaper than open wiring in the hand rail.

Wiring of cabs can be done either with wooden cleats, using ceiling buttons and reinforced lamp cord for drops, or a conduit system. The disadvantage of a conduit system in the cab is the difficulty of making repairs by the average headlight man in the roundhouses. With the open wiring it requires little experience to make necessary repairs. The expense of this system is about one-third of a conduit installation. A standard fixture for the water glass and steam gauge lamps should be adopted by each railroad. They should be designed so that the socket will be attached by means of a lamp guard or other means by which the socket can be taken off for repair. The practice of soldering fixtures on sockets should be discouraged.

The committee last year recommended S. B. W. P. copper wire, and while the majority of railroads are using this wire, there are others who feel that the No. 8 wire should be D. B. R. C. stranded copper wire. The cost of this wire will be almost four times the cost of weatherproof insulation, and it is extremely doubtful if it could be made to last four times as long. There are many arguments in favor of stranded copper wire, but its high cost of this wire is the greatest objection.

Where slow burning weatherproof wire is used, the slow burning insulation should be on the outside with the weatherproof on the inside.

The committee recommends that a standard list of repair parts be carried in stock at each terminal point, and that the general stock be concentrated at a general storehouse. Such a stock can be carried for about $15. When the number of engines justifies it an extra generator should be carried in stock at terminal points.

While all railroads have been experimenting for some time with Mazda, tungsten and nitrogen lamps for headlights, there is not on the market at the present time a concentrated filament high candle power lamp that has a sufficiently long life to justify its use. There seems no question but that such a lamp will be produced within the next few months, as all the manufacturers are now working along that line. When these lamps are a commercial article the arc lamp will be a relic of the past on engines, as well as for shop and yard lighting.

A system of weekly headlight reports is recommended, showing the number of engine lighting failures, amount of repair parts used and the labor of headlight men. This report should be signed by the headlight man in each roundhouse and O. K.'d by his foreman. This report should be forwarded to the men in charge of headlights over the entire system.

The committee calls attention to the battery headlights which are used with good results on the Southern Pacific. The lamps are 140 candlepower nitrogen filled tungstens and require 13 amperes at 6 volts. The lamps are mounted in standard oil lamp reflectors. They also use three cab lamps and two blizzard lamps on each locomotive.

The batteries have the capacity to run the entire lighting equipment for 13 hours. The batteries have an e. m. f. of 6 volts and a capacity of 300 amp. hrs. and the cells are made up of ironclad lead plates. They are mounted on top of the boiler and are removed each trip with a jib crane for charging.

* A committee report presented before the Association of Railway Electrical Engineers.

The Air Brake Association will hold its twenty-second annual convention at the Hotel Sherman, Chicago, Ill., on May 4, 5, 6 and 7, 1915.

Theoretical Discussion on Staybolt Breakage

By W. L. Turner and B. E. D. Stafford.*

From the following considerations, it is possible to arrive at some idea of the magnitude of the stresses and strains which are set up in locomotive firebox stays, due to the combined influences of flexure (which is caused by differences of expansion of the outer and inner sheets) and tension.

If a rod of metal of unit length, and of uniform temperature throughout, be raised in temperature through 1° F. it will increase its length by a certain fraction of its original length. Another additional rise in temperature of 1° F. will be attended by another equal increment of length, and so on. This ratio of the increase of length per degree F. to the original length, is termed the "co-efficient of linear expansion" of the material. This being known, it is possible to determine the change which will take place in the length of a given bar for a given rise in temperature, viz.:

For

Let L = Length of original bar.

Let C = Co-efficient of expansion (taken as .000007").

Let l = Increase of length.

Let t = Number of degrees rise in temperature.

Then for 1° rise $\frac{l}{L} = C$ or $l = CL$. Then for $t°$ rise, $l = CLt$.

$$\therefore \text{Final length} = L + l = L + CLt = L\,(1 + Ct) \quad (1)$$

Let us determine the movement or displacement of a member which is subjected to the combined action of two expanding rods:

Referring to Fig. 1, let one of the rods be horizontal and the other vertical, and let them both be fixed at points F_1 and F_2 to two immovable walls. Let P_1 be the position of a member P, which is connected to the extremities of these rods, and which is free to follow any path caused by their joint expansion. Upon the rods now being raised in temperature, the vertical one will tend to cause P to take up some position on the line P_1b, while the horizontal rod will simultaneously tend to force it out along the line P_1a. Completing the rectangle of forces, the resultant force is found to lie in the direction of the diagonal, P_1P_2, of the rectangle, and the resultant position of P will be at P_2, the end of the diagonal. The resultant deflection of P is shown by the length of the line P_1P_2, which length may be easily calculated.

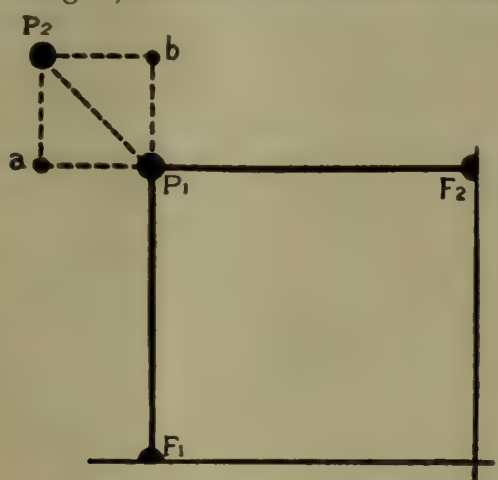


Fig. 1.

Let H = Horizontal Deflection, P_1a

V = Vertical Deflection, P_1b

$\triangle_1$ = Resultant Deflection, P_1P_2

Then

$$\triangle_1 = \sqrt{H^2 + V^2} \quad (2)$$

We can now assume that F_1, P_1, F_2 is the boundary line of a metal plate, and can accordingly calculate the resultant movements or change of position of any given point on the plate. Of course it is necessary to assume that certain points are fixed in position in order to find the expansion of other points. If this is not the case, the plate will expand equally in all directions from the center. In practice, we have an example of a plate expanding in the case of a locomotive firebox sheet, and also of a boiler sheet to which it is connected by means of bolts or stays.

Referring to Fig. 2 (deflection chart), it will be seen that this sheet is fixed along the bottom rivet line and is free to expand vertically upwards. It is not fixed on either of the vertical edges, so we must assume that it expands horizontally equally in both directions, and consequently we must take a datum line through the center from which to base our calculations.

Referring now to Fig. 3 (deflection chart), it is easy to see that if both plates do not expand equally together, the bolts connecting them, if rigidly installed, will be placed under a bending stress. The plates will expand equally if they are both always at the same temperature, but if not, there will be differences proportionate to the difference in temperature between the two plates. In practice, there is certainly a considerable difference existing, not perhaps when the locomotive is well in running order but especially so when it is being fired up or cooling down. Difference in thickness of plates, incrustation and circulation, are the chief causes which prevent the outer sheet immediately assuming the temperature of the firebox plate. We need, therefore, take no account of the absolute temperature of either of the sheets, but must only concern ourselves with the existing differences.

Let us assume that we know these differences, and have calculated the deflection produced on any given bolt or bolts. We next require to find out, by considering the strains produced in the flexure of beams, the extent of stresses in the staybolts corresponding to these deflections:

Let S = Fibre stress in pounds per square inch.

c = Distance of fibre from neutral axis = radius of bolt to bottom of thread.

E = Modulus of Elasticity = 26,000,000 pounds per square inch for staybolt iron.

R = Radius of Curvature of Elastic Curve.

I = Moment of inertia of section $= \frac{\pi d^4}{64}$ for circles.

P = Load on end of beam.

l = Length of beam, in inches, under flexure.

M = Bending moment = Pl.

$\triangle$ = Deflection, in inches, of beam.

For any beam

$$\frac{S}{c} = \frac{E}{R} = \frac{M}{I} \quad (3)$$

and for a cantilever beam with the load concentrated at its free end

$$\triangle = \frac{Pl^3}{3EI} = \frac{Ml^2}{3EI} = \frac{SI}{c} \times \frac{l^2}{3EI} = \frac{Sl^2}{3Ec} \quad (4)$$

Solving for S, we obtain

$$S = \frac{3\triangle Ec}{l^2} \quad (5)$$

It must be remembered that these formulas are only true when all the fibres of the beam are in the elastic condition. By means of them, it is possible to determine the limiting stresses and deflections for any material in the elastic state.

Take the case of an iron staybolt, 1" diameter, where,

S = Elastic Limit = 30,000 pounds per square inch.

E = 26,000,000 pounds per square inch.

l = 4".

c = .428".

We have

$$\triangle = \frac{30{,}000 \times 16}{3 \times 26{,}000{,}000 \times .428} = .0144''$$

*An article in "Staybolts," the house organ of the Flannery Bolt Co.

This is less than $\frac{1}{64}''$ but any greater deflection will put the outermost fibres beyond the limit of elasticity.

It is not to be inferred that a bolt will necessarily break quickly if its deflection reaches this amount, or a slight amount over it. Breakage of staybolts is simply due to fatigue caused by numerous repeated bendings backward and forward. Experiments have shown that so long as the material is elastic throughout, it cannot be broken by any number of reversals, however great, but, if this is not so, the number required to break it will depend on the degree to which the material is strained beyond its elastic limit. In practice, there is a large number of bolts which have just passed this limiting deflection, but which do not always break down in service, since the time required to put them through the large number of reversals necessary for fracture is greater than the life of the firebox sheet.

Hitherto, no account has been taken of the fibre stresses due to tension caused by the pressure in the boiler. All such stresses must be added to those caused by bending. We consequently see that owing to this, a smaller deflection will be required to put the staybolt in the breaking zone than if there has been no such pulling action. Taking the case of tension, we have for bolts 4" pitch, .856" diameter bottom of thread (.5754 square inch area) and a pressure of 200 lbs. to the square inch, a pull of 4 x 4 x 200 lbs. to be resisted. The fibre stress per square inch will be

$$\frac{4 \times 4 \times 200}{.5754} = 5560 \text{ lbs. per sq. in.}$$

Call this S_1 and let us proceed to work out a formula to give us the limiting deflections, taking into account the effect of tension.

Let $\triangle_2$ = This limiting deflection.

S = Elastic limit fibre stress = 30,000 lbs. per sq. inch.

S_2 = Fibre stress due to flexure alone = $\dfrac{3\triangle_2 Ec}{l^2}$

Then,

$$S = S_1 + S_2 = S_1 + \frac{3\triangle_2 Ec}{l^2}$$

$$\therefore \frac{3\triangle_2 Ec}{l^2} = S - S_1$$

$$\therefore \triangle_2 = \frac{l^2 (S - S_1)}{3\,Ec} \quad \text{.............................} (6)$$

$$\text{or } \triangle_2 = \frac{4^2\ (30{,}000 - 5560)}{3 \times 26{,}000{,}000 \times .428} = \frac{16 \times 24{,}440}{33{,}384{,}000} = .0117''$$

Therefore the allowable deflection of a staybolt 4" long is .0117". Any deflection greater than this will put the outermost fibres of the rigid staybolt beyond the limit of elasticity.

The following apply to the staybolt deflection chart and tables.

For finding the deflection of a staybolt due to the expansion of firebox sheets:

Formula No. 1 H and $V = DTC$.

Formula No. 2 $\triangle_1 = \sqrt{H_2 + V_2}$. See Table I.

Where H = Horizontal deflection.

V = Vertical deflection.

$\triangle_1$ = Resultant deflection.

D = Distance in inches from Datum Line.

T = Temperance of fire sheet over outer boiler sheet.

C = Co-efficient of expansion = .000007".

For determining the limiting stresses and deflections for any material in the elastic state, as in the bending of a staybolt, where the amount of deflection is required which will strain the material up to the yield point or Elastic Limit:

Formula No. 3 $\triangle_2 = \dfrac{l^2 (S-S_1)}{3\,Ec}$ See Fig. 3.

Where $\triangle_2$ = Deflection.

S = Elastic limit fibre stress = 30,000 lbs. per sq. in.

S_1 = Fibre stress due to tension alone.

l = Length of bolt under flexure.

E = Modula of Elasticity = 26,000,000 lbs. per sq. in.

c = Radius of 1" bolt, bottom of V thread = .428".

Formula No. 4 $T = \dfrac{50 \times \triangle_2}{\triangle_1}$ See Table 2.

A difference of 50° F. in temperature of fire sheet over outer boiler sheet taken as a basis.

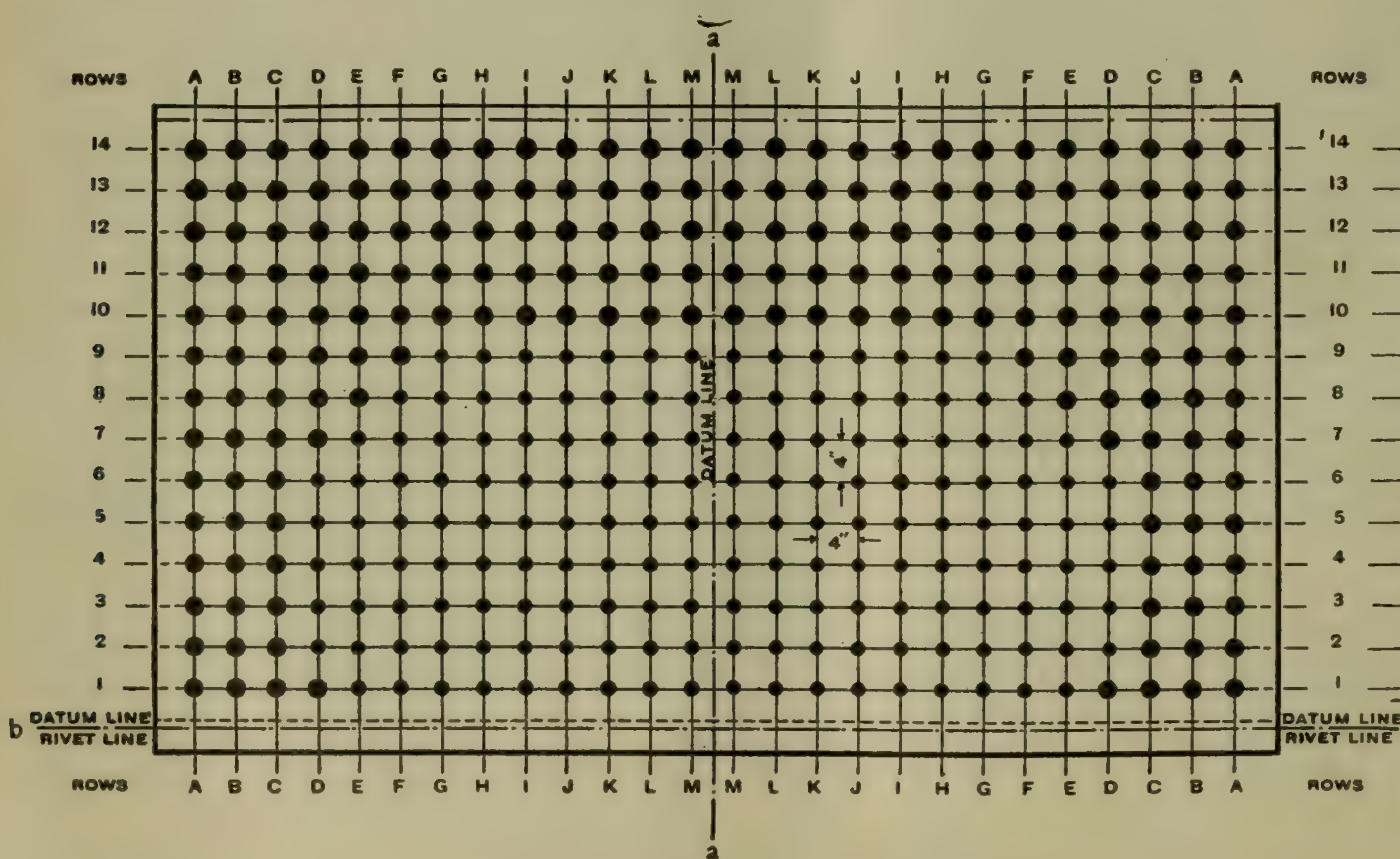


Fig. 2—Layout of Staybolts in Side Sheet.

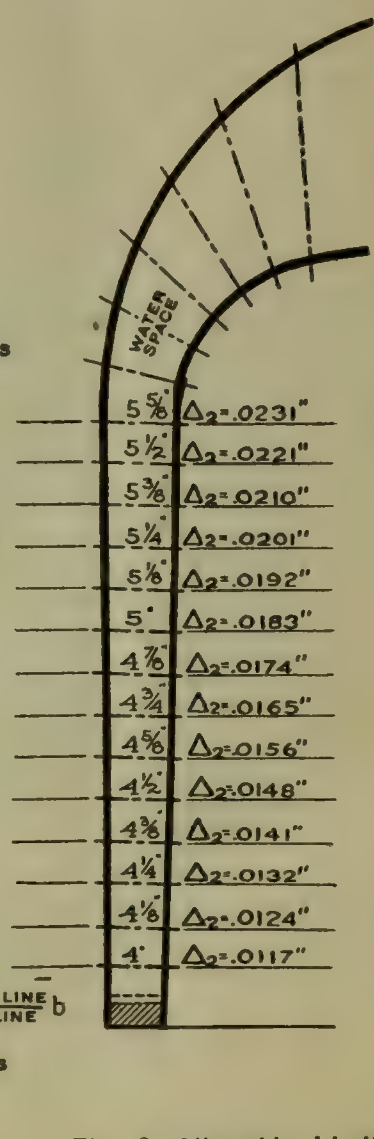


Fig. 3—Allowable Limits of Staybolt Deflection.

Table 1—Resultant deflection of staybolt (Δ_1) due to fire sheet expansion. Fire sheet temperature 50° F. higher than outside boiler plate.

Vert Bolt Row	A	B	C	D	E	F	G	H	I	J	K	L	M
Bolt Row Horz	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1	Deflection Δ_1
1	.0176	.0162	.0148	.0134	.0120	.0106	.0092	.0078	.0065	.0051	.0037	.0025	.0016
2	.0178	.0163	.0150	.0136	.0122	.0109	.0096	.0082	.0069	.0057	.0045	.0035	.0030
3	.0180	.0166	.0153	.0140	.0126	.0113	.0100	.0088	.0076	.0065	.0055	.0047	[illegible]
4	.0184	.0171	.0157	.0144	.0132	.0119	.0107	.0095	.0085	.0075	.0066	.0060	.0057
5	.0189	.0176	.0163	.0151	.0139	.0127	.0115	.0104	.0095	.0086	.0079	.0073	.0071
6	.0195	.0182	.0170	.0158	.0146	.0135	.0125	.0114	.0106	[illegible]	.0092	.0087	[illegible]
7	.0201	.0189	.0177	.0166	.0155	.0144	.0134	.0125	.0117	.0110	.0105	.0101	.0099
8	.0208	.0196	.0185	.0175	.0164	.0154	.0145	.0136	.0129	[illegible]	.0118	.0115	.0113
9	.0216	.0203	.0194	.0184	.0174	.0165	.0156	.0148	.0142	.0136	.0132	.0128	.0127
10	.0224	.0214	[illegible]	.0194	.0184	.0176	.0167	.0161	.0154	.0149	.0145	.0142	.0141
11	.0234	.0223	.0214	.0204	.0195	.0187	.0180	.0173	.0167	.0162	.0159	.0156	.0155
12	.0243	[illegible]	.0224	.0215	.0207	.0199	.0192	.0185	.0180	.0176	.0172	.0170	.0169
13	.0253	.0244	.0235	.0226	.0218	.0211	.0204	.0198	.0193	.0189	.0186	.0184	.0183
14	.0264	[illegible]	.0246	.0238	.0230	.0223	.0216	.0211	.0207	.0203	.0200	.0198	.0197

To obtain deflection for any number of degrees temperature (X), multiply the 50° reading by $\frac{X}{50}$

Table 2—Difference in the temperature of plates required (T = degrees F) to strain each bolt to its elastic limit according to its location in side sheet

Vert Bolt Row	A	B	C	D	E	F	G	H	I	J	K	L	M
Horz Bolt Row	T	T	T	T	T	T	T	T	T	T	T	T	T
1	33.2	36.1	39.5	43.6	48.7	55.1	63.5	75.0	90.0	114.7	158.1	234.0	365.6
2	34.8	38.0	41.3	45.6	50.9	56.8	64.5	75.6	89.8	108.7	137.7	177.1	206.6
3	36.6	39.7	43.1	47.1	52.3	58.3	66.0	75.0	86.8	101.5	120.0	140.4	150.0
4	38.3	41.2	44.8	48.9	53.4	59.2	65.8	74.2	82.9	94.0	106.8	117.5	123.7
5	39.1	42.0	45.4	49.0	53.2	58.2	64.3	71.1	77.9	86.0	93.6	101.3	104.2
6	40.0	42.8	45.8	49.3	53.4	57.7	62.4	68.3	73.6	79.6	84.7	[illegible]	91.7
7	41.0	43.6	46.6	49.7	53.2	57.2	61.5	66.0	70.5	75.0	78.5	81.6	83.3
8	41.8	44.4	47.0	49.7	53.0	56.5	60.0	64.0	67.4	70.7	73.8	75.6	76.9
9	42.3	44.6	47.1	49.7	52.5	55.4	58.6	61.8	64.4	67.2	69.3	71.5	71.2
10	42.8	44.7	47.2	49.4	52.1	54.5	57.5	59.7	62.3	64.4	66.2	67.6	68.0
11	42.9	45.0	46.9	49.2	51.5	53.7	55.8	58.0	60.1	62.0	63.2	64.4	64.8
12	43.2	45.0	46.8	48.8	50.7	52.7	54.7	56.7	58.3	59.7	61.0	61.7	62.1
13	43.7	45.2	47.0	48.9	50.7	52.3	54.1	55.8	57.2	58.4	59.4	60.0	60.3
14	43.8	45.4	46.9	48.5	50.2	51.8	53.4	54.7	55.7	56.9	57.7	58.3	58.6

$$T = \frac{50 \times \Delta_2}{\Delta_1}$$

Tables 1 and 2.

Deflections according to other differences in temperatures may be found by multiplying the 50° reading by $\frac{x}{50}$ thus, with a difference of Plate Temperature of 75° F., what would be the deflection of bolt A.1?

Fifty degree reading in Table 1 shows for bolt A.1. a deflection of .0176" for 75° the deflection would be $\frac{.0176 \times 75}{50} = .0264''$

Fig. 2 represents the layout of a locomotive firebox side sheet with staybolts pitched 4" apart.

The heavy circles show staybolts covering what is known as the "breaking zone" of the rigid or ordinary staybolt, which is simply a straight bar of iron threaded its entire length and screwed through outer shell of boiler, across the water space and into firebox sheet, when both ends are riveted over, thus forming a rigid stay, securely connecting firebox to outer boiler shell.

Under temperatures of working pressure all heat absorbing plates expand more or less according to the varying temperatures of furnace and boiler operation, and the relative sheet expansion is very irregular and affects staybolts accordingly as they bend and deflect under stress of unequal sheet expansion, inducing an alternating stress, which when repeated continually, renders the material structure of the staybolt as weak as the stress exceeds the elastic limit.

Fig. 3 shows the allowable limits of staybolt deflection not to exceed, covering the several lengths of water space stays generally used in the types of firebox shown from mud ring to crown line, and any deflection greater than these shown, for each row and length, will strain the staybolt material and render same useless.

Table 1 shows the resultant deflections of staybolts when firebox plate is 50°F. higher than temperature of outer shell. Any deflection greater than that shown in the same row, Fig. 3, based on this difference of plate temperature, will render the bolt weak and unsafe.

Table 2 shows the difference in the amount of temperatures, between plates under expansion, which will deflect a staybolt beyond the elastic limit by repeated bending in the locations given.

These charts and tables are presented for the purpose of pointing to the fact that inequality of sheet expansion in locomotive boilers is a most vital subject to consider in dealing with the causes that lead to staybolt breakage, likewise proving the futility of the rigid staybolt, and the advantages of the flexible stay to cope with conditions existing.

WELDING ON THE CENTRAL OF GEORGIA RAILWAY.

By C. L. Dickert, Asst. M. M., Macon, Ga.

Electric and oxy-acetylene welding is being used on the Central of Georgia Railway to great advantage. Both plants are stationary, with wiring and piping conveniently arranged throughout erecting and boiler shops, for handling work at any point with both systems.

Each method of welding, as I see it, has its advantages: electric for welding flues to back flue sheet; oxy-acetylene for cutting, welding cast iron, and brazing brass. Both systems make a very complete arrangement in a railroad shop, and to get the full benefit of cutting and welding of this nature each shop should be equipped with them both.

Both methods are being used extensively on general work. The best method for each class of work is determined only after a thorough test has been made, from an economical and efficient standpoint. The electric welding outfit is a paying proposition on flue welding alone, saying nothing of its unlimited field for welding on boiler, firebox work, steel and wrought iron parts of all sorts. The oxy-acetylene, likewise, is a paying proposition for cutting, welding cast iron, malleable and brazing brass. This method also has an unlimited field for welding on boiler, firebox work, steel and wrought iron parts.

One great advantage we find with the electric is the extreme localization of the heat, thus avoiding large heated portions of metal adjacent to the place where the weld is being made. Consequently, when the work cools no strains are set up, causing failure of weld or buckling of sheets. This holds true especially in welding in firebox patches, half side sheets, half door sheets, etc.

The oxy-acetylene, however, can be handled very successfully on this same class of work, but more care is used in figuring on and taking care of expansion and contraction.

Our greatest trouble has been that the welding appears too easy to the operators, and at times we have failures with both systems due to carelessness of operators, most failures being man failures that could be avoided by operator using good judgment.

The preparation of patches or any part to be welded is practically the same with both systems. On boiler plate work, each piece to be welded is beveled 45 degrees, bringing the two inner edges together, and the piece to be welded in is bolted securely with temporary bolts and ripper $\frac{3}{16}$" thick is run through seam to get rid of feather edges. This done to insure a thorough weld on inner side of sheets. The weld is reinforced 60% of thickness of sheet for strength. Other parts to be welded are beveled in a like manner.

When welding flues to back flue sheet they are applied in the usual manner, with copper ferrules, roll, bead and prosser. When applying copper ferrules, care should be taken to get ferrule below face of flue sheet, as a good weld cannot be made where copper ferrule is exposed. After flues are applied test pressure is put on boiler and all leaks stopped. Flues are then welded to sheet.

Where flues that are in service are to be welded the sheet is cleaned with sand blast and flues reworked before welding in. Flues are welded in all heavy power as they pass through shop. On superheater engines, both large and small flues are welded in. Welding in flues has practically eliminated our flue troubles. In several instances we have been able to save application of new flue sheet and flues by welding in with the electric welder. One engine in particular was shopped for new back flue sheet and as we had just installed the electric outfit we decided to experiment by welding in flues. This was done May 22, 1913; the engine is still in service and to date has not given a minute's trouble.

We use the oxy-acetylene burning torch to a great advantage in removing fireboxes. The box is cut up in sections to scrap specifications, staybolts and radials are drilled through wrapper sheet and back head, and rivet burster is used for breaking loose staybolts from wrapper sheet. The burning torch is used for cutting out patches and half side sheets, cutting out frames for thermit welding, cutting up scrap boilers, etc.

We are building up crosshead fits on piston rods when loose,

worn guides, cellar bolt holes in driving and truck boxes, worn links and motion work, reverse levers, worn engine frames, plugging holes and, in fact, all parts of locomotive and machinery that can be reclaimed economically, with electric and oxy-acetylene.

We have been very successful in welding cast iron with oxy-acetylene; however, it is a very difficult job and requires an expert operator. We find it necessary to preheat the entire piece to be welded, before welding; then after weld is made, while piece is hot, it is covered over with ground-up asbestos and allowed to cool. This is done to prevent cooling off too rapidly, bringing about undue strains, which in most every case would fail when shrinkage takes place.

We have not been able to weld cast iron successfully with the electric outfit; however, we have made some few welds on cast-iron smoke-box doors and rings, which are holding up all right so far. But on parts that are under pressure or strain we have not been able to weld successfully.

Our operators are blacksmiths, boilermakers, machinists and coppersmiths. Blacksmiths do all welding on wrought iron, steel and cast steel; boilermakers do all boiler plate, tank, ash pan, cab and sheet steel work; machinists handle all cast iron and malleable; and coppersmiths handle pipe work and brazing brass. We have regular men on this work and teach others in each department to fill in when the regular operator is out. One man is assigned to look after oxy-acetylene plant, charge generators, keep up equipment, etc. He also handles cast iron and malleable welding, and assists other operators when necessary.

Frame welding is mostly done with the thermit process, which has proven very satisfactory, and we have gotten the cost down to a minimum. We have, however, welded a few light sections of frames with the electric and oxy-acetylene, they having been in service some time and have given no trouble.

The different methods of welding, commonly known as autogenous welding, have stepped into railroad shops and filled a long felt want. With their aid we have been able to reduce cost of repairs on work that they are especially adapted for. Mileage of flues is increased; maintenance cost of flues decreased; we reclaim worn parts that otherwise would have to be renewed at a much greater cost; remove fireboxes with the cutting torch; weld broken locomotive frames without removing from boiler; apply patches, half side sheets and door sheets; cut up scrap boilers, etc. In fact, we figure a saving on everything that is being done with the different methods of welding in use in our shop.

HARDENING STEEL IN A FORGE.

By Albert A. Dowd.

Many factories use the lead-bath system for hardening high-speed steel, and while this arrangement may be very convenient and save considerable time, it is more than doubtful whether the results obtained are really economical because of the variations in cutting efficiency, which are largely caused by this method.

Several years ago, while making some tests of high-speed steels of various makes to determine the most satisfactory results under very severe working conditions, I had occasion to visit the blacksmith shop to have some tools rehardened. While waiting for the blacksmith to finish the work he was doing, I watched the hardening process with considerable interest. The blacksmith took a tool and warmed it for about half a minute over the forge fire until he had taken the chill out of the steel, and then plunged the cutting edge into a lead bath having a temperature of about 1500° F. After it had attained a bright red color, it was quickly removed to another lead bath, the temperature of which was kept at 2050° to 2100°, thus bringing the tool up to the required heat very rapidly, after which it was quenched in an oil and brine bath. I handed the tools which I had brought in over to the blacksmith and told him that they were soft and I wanted them rehardened as soon as possible. They were sent back to me, having supposedly been put through the same process of hardening as those which I had seen while in the blacksmith shop. After regrinding they were again tested and found wanting, being only a little better than before. This was very disappointing and looked as if the steel was not up to the mark. In order to make certain regarding the point, I decided to make another test with a couple of entirely new tools on the same piece of steel.

It has always been a fixed impression with me that a tool should be heated very slowly for hardening, because the rapid heating has a tendency to open up the structure of the steel to such an extent that the molecules are so separated that they become less tenacious. When quenched, a close-grained structure is not obtained, and soft spots are very apt to be found, while there is also a lack of cohesion that leaves the tool in such condition that it fractures easily, and is therefore short-lived. To test this matter, I asked the head blacksmith if he would handle them in a somewhat different way, as I wished to test the cutting of the two tools which had been hardened differently. The first tool was hardened by placing it in a forge with an ample supply of fuel between it and the blast nozzle, and was heated gradually until the cutting edge had attained a bright-red heat. The blast was then forced and the temperature raised quickly until the color had just verged on a pure white on the cutting edge about 2200° F. It was then quenched in a bath composed of 25 gallons of paraffin oil and the same quantity of lard, and 1 bushel of salt. It should, of course, be understood that only the cutting edge was carried to the heat mentioned, and the tool when being quenched was kept in constant motion, the cutting edge only being dipped in the solution at first, but finally the whole tool was immersed until cool. No attempt was made to draw the temper. The other tool was simply heated over the forge fire until it was well warmed through, and was then carried to a bright red in the first lead bath and brought up to the final heat in the other, the quenching process being the same. The tools were marked for identification, and were ground and tested.

The test showed that the first tool was superior to any of the others which had been tested, while the second one was also considerably better than any previous lot. Tools which had been treated by the lead-bath method in the first place were sent back to be rehardened by the forge method. After this they were tested and gave excellent results. Among the points brought out by these experiments were that the structure of the steel was undoubtedly injured when the tools were heated too rapidly, and also that the temperature of the highest lead bath fluctuated between 2000° and 2100°, as shown by the pyrometer test, the combination of these two factors having had such an effect on the tools that their efficiency was impaired. In the first place, the structure of the steel was injured, and in the second the heat of the final lead bath was insufficient by from 100° to 200° to give a heat sufficiently high for hardening. When using the fire end of the pyrometer in the high temperature lead bath it was noted that the needle of the indicator was so sensitive to even a slight movement of the blacksmith's hands as he tried the heat of the lead with the fire end, that it was difficult to determine the heat exactly, as the needle vibrated between 1950° and 2100°.

The heat was therefore increased until the needle fluctuated between 2100° and 2200°, and another tool was carried through by the lead-bath method and showed a greater life and a much greater cutting efficiency. Although none of the tools hardened by this method was quite as good as those which were forge-treated throughout, they were very much better than those treated by the original method and put into the first lead bath in a comparatively cool state.

There are some manufacturers who have dispensed with the lead bath in treating high-speed steels and use the forge method entirely, judging the heat by the color of the heated metal, and one of these obtained the hardest and longest-lived tools I have ever seen. There was one high-speed tool which was used on chilled cast-iron tire moulds with a feed of $\frac{1}{16}$ inch, a speed of 40 feet, and a chip ranging from ¼ inch to ⅜ inch for four months without regrinding. At the end of this period it was still in first-class working condition. This is a remarkable record for a roughing tool, and I have never known it to be equaled. The tool was hardened by the forge method throughout and cooled in the solution previously mentioned.—*Iron Age.*

STEAM LOCOMOTIVES OF TODAY.*

Steam and electric locomotives as rivals in the same field has been a favorite subject for discussion before engineering societies and it is easy to start arguments in favor of each of these rivals among the partisans interested. Whether or not the steam locomotive is to be displaced by the electric is, of course, an important question which will in time be settled by the court that settles all such questions, that of the treasurer's figures. For the present and for the immediate future the burden of transportation falls and will continue to fall upon the steam locomotive. If the steam locomotive is to be perpetuated it is fitting that it should be improved to the utmost limit. If it is to be finally displaced it is fitting that it shall be so improved in order that progress to something better shall be intelligently developed upon a solid foundation. This discussion will be confined to the steam locomotive, its progress in the recent past and its possibilities for the near future.

PROGRESS IN CAPACITY.

While efforts individual in character and extent were made in this country before that time, the first consistent and systematic plan to secure the utmost power of locomotives within given restrictions of weight and cross-section clearance was inaugurated 20 years ago. This plan began with an eight-wheeled or American type passenger locomotive, built for an eastern railroad in January, 1895. This locomotive weighed 116,000 lbs., with 74,500 lbs. on driving wheels. It provided a tractive effort of 21,290 lbs. While this locomotive was not the most powerful in passenger service at that time, it was the first of a chain of passenger locomotives leading in a connected series, by the same builders, up to and including recent designs of the Mountain type, representing the largest passenger type of present practice. This type has four-wheel leading trucks, eight driving wheels and two trailing wheels. The largest of the Mountain type weighs 331,500 lbs., with 240,000 lbs. on driving wheels and produces a tractive effort of 58,000 lbs. or about three times the tractive effort of the first design of the series built during a period of 20 years.

In the year 1898 the engineering and railroad world was interested by the appearance of the largest and most powerful locomotive built up to that time. This was the Consolidation type with a two-wheel leading truck and eight driving wheels. This locomotive was built in Pittsburgh and for a number of years was the largest and most powerful of its type, and the largest and most powerful locomotive in the world. Its total weight is 330,000 lbs. weight on drivers 208,000 lbs. and tractive effort 53,000 lbs.

Today the most powerful freight locomotive has two leading and two trailing wheels and 24 driving wheels. It gives a tractive effort of 160,000 lbs. and weighs 410 tons. This locomotive has hauled a train of 251 freight cars weighing 17,912 tons, exclusive of the locomotive. The total length of the train was 1.6 miles, the maximum speed attained was 14 miles per hour. This required a maximum drawbar pull of 130,000 lbs. This locomotive has six cylinders and three groups of driving wheels.

A freight locomotive has recently been built having two cylinders and a single group of driving wheels which develops a tractive effort of 84,500 lbs. Such has been the progress in capacity.

This progress has been rapid, perhaps somewhat too rapid with respect to improvements in operating facilities and progress in other features of railroad equipment. It has been rendered possible by corresponding developments of factors making for greater efficiency in boilers and in engines. During the past 20 years in this country locomotive development in capacity and in efficiency, particularly during the past five years with respect to efficiency, has been remarkable and is worthy of record with progress in marine and stationary engineering.

In Europe the relatively high cost of fuel led to efforts to improve efficiency before this problem aroused serious attention in this country, but physical limitations more rigidly restricted the size and weight of locomotives in Europe. Our problem is to secure maximum efficiency combinel with great size, great weight and great power which is more difficult. Since the development in the size and weight has been tremendous, even though these limits may not yet have been reached, it is now appropriate to concentrate on efficiency.

For a number of years the physical capacity of the fireman to shovel horsepower through the fire door determined the capacity of the locomotive at speeds. Mechanical stokers have removed that limitation. It is now possible to fire six tons, and more, of coal per hour into a locomotive firebox. This has changed the problem into one of getting the maximum amount of heat out of the coal and using it economically in the cylinders. With the large figures now prevailing for drawbar pull and weight it is fitting that closest attention should be given to the best possible use of every pound of metal and every pound of coal. Due to recent application of several economy producing and capacity increasing factors great improvements have already been made with promise of more to come. Then the great work of building up the efficiency of the average locomotive to the standard of the best will follow.

Among these economy producing and capacity increasing factors are the following improvements:

Boiler design in relationships of the factors making up heating surface.

Firebox design.

Front and design, draft appliances, exhaust nozzles.

Ashpan design as to air openings.

Superheating.

Compounding.

Feedwater heating.

Firebrick arches and circulating supporting tubes.

Valve gear.

Detail design to secure reduced weight of reciprocating parts and other parts.

Use of high-grade alloy steels to reduce weights.

Mechanical stokers.

Labor-saving devices for the engineman and fireman.

Improved counterbalancing to permit of greater weight on driving wheels by reducing dynamic stresses.

And yet to come is powdered fuel with possibilities unknown in scope and in importance. Powdered fuel is in reserve, promising the ideal method of complete combustion under control more perfect than is possible with present methods other than oil burning and perhaps with economies impossible to obtain with oil.

PROGRESS IN EFFICIENCY.

Valuable comparisons may be drawn from the best results of ten years ago and of today. At the Louisiana Purchase Exposition in 1904 the tests made by the Pennsylvania Railroad revealed important figures concerning locomotive performance at that time. It was shown to be possible to obtain equivalent evaporation from and at 212 deg. of 16.4 lbs. of water per sq. ft. of heating surface, indicating the power of locomotive boilers when forced. It was shown that when the power was low, the evaporation per pound of coal was between 10 and 12 lbs., whereas the evaporation declined to approximately two-thirds of these values when the boiler was forced. These results compared favorably with those obtained in good stationary practice, whereas the rate of evaporation in stationary practice lies usually from 4 to 7 lbs. of water per ft. of heating surface per hour. In steam consumption the St. Louis tests showed a minimum of 16.6 lbs. of steam per i. h. p., per hour. In coal economy the lowest figure was 2.01 lbs. of coal per i. h. p., the minimum figure for coal per dynamometer h. p. was 2.14 lbs. These records were made after the superheater had become a factor in locomotive practice and they represent economies attained by aid of the superheater in one of its early applications. This is important in the light of the recent development of the superheater. These remarkable figures have never received the attention which they deserve from engineers. They serve, however, to show that 10 years ago a steam locomotive had attained results which were worthy of the best attention of the

*Report of the subcommittee on railroads for presentation at the annual meeting of the American Society of Mechanical Engineers at 29 West 39th street, New York, on December 2, 1914. The report is signed by G. M. Basford, F. H. Clark and W. F. Kiesel, Jr.

engineers of the time. Since then greater progress has been made and today locomotives of larger capacity than those concerned in the St. Louis tests have given better results.

Voluminous records of recent investigations of locomotive performance taken from the Pennsylvania Railroad test plant at Altoona show that the best record of dry fuel per i. h. p.-hr. down to the present date is 1.8 lbs. with a large number of less than 2 lbs., while the best performance in dry steam per i. h. p.-hr. is 14.6 lbs. with a large number less than 16 lbs. A reduction of 10 per cent in fuel and 12 per cent in water is remarkable as a result of a development of 10 years. This coal performance was recorded by a Class E 6 S Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 1245.1 i. h. p. The same locomotive gave a fuel rate of 1.9 lbs. while running at the same speed and developing 1750.9 i. h. p. The best water rate was given by Class K 2 S A Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 2033.1 i. h. p. These high powers indicate that the locomotives were not coddled as to output of power in order to show high efficiencies, but that high efficiencies accompany actual conditions of operation in severe service. As to power capacity expressed in terms of evaporation, it is interesting to note that the maximum equivalent evaporation from and at 212 deg. per sq. ft. of heating surface per hour on the Altoona test plant is 23.3 lbs. These figures of high efficiency were obtained from locomotives which represented not only very careful, general and detail design, but their design included several of the improvements making for greater capacity and higher efficiency, without which the results could not have been attained.

Having in mind the facts that steam locomotives are power plants on wheels, built to meet rigid limitations of weight, both static and dynamic, and that the use of condensers is impossible, engineers in general must admit the high character of the work of locomotive designers which has attained these results.

Greater efficiency which is revealed on the test plant and through reports of engineers would be important because it proves that progress is being made in the possibilities of locomotive performance. Improvement which is revealed by operating statistics and which, therefore, appears in the records of the treasurer's office is the real test in this case. It is important to know that increased power of locomotives attained largely through the development of economy producing and capacity increasing factors has produced results which the financial reports of railroads prove beyond question. A recently published list of train tonnage on 45 prominent railroads indicates that 16 of these roads have increased their average freight train loads by over 30 per cent during the last five years. Credit must be given to the improvement in the locomotive for most of this development. These figures reveal the value of increased power and efficiency of steam locomotives and the end is not yet in sight.

WHAT REMAINS TO BE DONE.

American locomotive development to its present state would have been impossible without the use of the improvements already mentioned. It is believed that all these are capable of still further development, making for still greater economy in the use of fuel and, therefore, promising greater power capacity. It is the object of the committee to present power capacity for discussion by those who are engaged in perfecting and improving steam locomotice practice in this country. It is the hope of the committee that engineers who are devoting their attention to the design of locomotives as a whole and those who are engaged in the development of the various details which have contributed to the high efficiency of the steam locomotive of today will discuss the progress of the recent past and reveal possibilities for future development and improvement in capacity and efficiency.

KANSAS CITY, Mo., on November 1, opened up its new Union station, of which it is justly proud. The project included the construction of a belt line around the city and the construction of two freight yards, in addition to the new $6,000,000 station. The entire project cost over $40,000,000.

RAILWAY ELECTRICAL ENGINEERS.

The Association of Railway Electrical Engineers held its seventh annual convention at the Hotel La Salle, Chicago, on October 27 to 30, 1914. The sessions were presided over by the president, C. R. Gilman, of the Chicago, Milwaukee & St. Paul. In his address at the opening of the convention, he spoke of the work accomplished in past years and outlined the future work of the association.

On Tuesday afternoon the committee on loose leaf binders made its report. At the mid-year meeting this committee made a report recommending a 6x9 inch size of sheet and only a progress report was made at this time. The committee on data and information contributed some interesting matter on car lighting, shop and station equipment and traveling cranes. A summary of lighting units in railroad service was presented in the following table.

	Total Number Reported	Per Cent
A. C. Arc Lamps	9,600	21
D. C. Lamps	8,096	17.7
Magnetite Arc Lamps	1,429	3.1
Flaming Arc Lamps	1,252	2.3
500-watt Tungstens	734	1.6
400-watt Tungstens	1,576	3.5
250-watt Tungstens	11,205	24.7
150-watt Tungstens	9,030	19.8
Nitrogen Filled Tungstens	489	1.7
Cooper-Hewitt	1,516	3.3
Quartz Tube	55	.1
Nernst Lamps	570	1.2

Other tables were presented showing car lighting costs and the number of lamps, generators, shop motors, electrically operated transfer tables and turntables in use on roads in this country. Four tables were devoted to the number of the various types of motors in service. The committee stated that a very chaotic condition exists in the matter of motor sizes for traveling shop cranes and presented a table grouping the cranes reported by tons capacity together with the horse power of the various motors. The following comment was made on this table: "There is an extremely wide variation in motor sizes, take for instance, the 5 ton crane: Here we find a variation in main hoist motors from 2 h. p. in the first, to 30 h. p. in the last. A similar variation and lack of uniformity seems to exist in both traction and side movement motors, and further, there seems to be no definite relation between the sizes of side movement, traction, and main hoist motors. A similar variation seems to exist among all the crane sizes."

The first order of business on Wednesday morning was the report of the committee on standards. Its recommendations covered axle pulleys, generator pulleys and taper fits on armature shafts. The committee co-operated with the car lighting companies in its work. Charles R. Sugg, of the Atlantic Coast Line, presented the report of the committee on electric headlights which is republished elsewhere. The report on electric traction is also reproduced elsewhere. The committee on industrial trucks recommended a standard capacity of 4000 pounds, a speed of 5 miles per hour and a potential of 24 volts for general industrial truck service. Standards for tires and wheel sizes were also given, a 2" depth of tire being recommended. Wednesday's program was concluded with the reading of a paper by Frederick H. Millener, of the Union Pacific, on "The Wireless Telegraph and the Wireless Telephone as an Adjunct in the Operation of a Railroad." Dr. Millener gave a review of the work he has done in this line of the Union Pacific and illustrated it with lantern slides.

On Thursday morning the committee on head end equipment presented the results of its investigations which consisted in the main of a description of the head-end system recently placed in operation on the Northern Pacific by the Gould Coupler Co. The following is an extract from the report:

"The saving on other roads of course depends on the wages paid to train electricians and other details of operation, but

in any case it would no doubt be considerable. This because the efficiency of the locomotive is approximately four times that of the turbine at one-third load and also because with the Unit Axle System all manual attention on the road is unnecessary. It has also proved unnecessary on the Northern Pacific to add local or terminal inspectors due to the use of this system. The men who have taken care of the steam head end sets have no trouble taking care of the unit axle machines. In fact, due to the fact that no terminal charging is necessary with the Unit Axle system, they have more time to spend on inspection of machines.

"The saving in coal, which we find amounts to approximately one and one-half tons per night, not only effects a considerable money saving, but also makes it easier for the power to handle the trains in cold weather."

A committee of which S. W. Everett (A. T. & S. F.) was chairman, presented standard rules for car wiring, covering conduits, wires, switchboards, regulator lockers, fixtures, generators and suspension, battery boxes, charging receptacles and fans. Reports were also received on outside construction and yard lighting and on illumination. The later report was confined to the completion of the report on the day coach lighting tests; the investigation of special subjects; the illumination of classification yards, and a resume of recent developments in arc and incandescent lamps.

The committee on wire specification had prepared a comprehensive report on the subject which was read to the convention.

On Friday the report on shop practice was read. A report on yard facilities for charging batteries was also presented to the convention. The following officers were elected for the coming year: President, H. C. Meloy, L. S. & M. S. Ry., Cleveland O.; 1st vice-president, E. W. Jansen, Illinois Central R. R., Chicago; 2nd vice-president, C. J. Causland, Penn. R. R.; secretary-treasurer, J. A. Andreucetti, Chicago & North Western Ry., Chicago. The manufacturers' exhibit was an excellent one, covering both the ball room and the Red room.

GAS-ELECTRIC MOTOR CAR, S. P. & S. RY.

The Spokane, Portland & Seattle Railway has contracted with the General Electric Company for a gas-electric motor car, which will be the first car of this type to be employed on this railway. It is the intention to place the car in operation between Portland and Rainier, Ore., on the Astoria-Columbia division of the road.

Steam trains are now making two round trips each way per day between these two cities, 45.8 miles apart, leaving Rainier 7:40 a. m., arriving at Portland 9:40 a. m., and leaving Portland 12:50 p. m., arriving at Rainier 2:40 p. m.; leaving Rainier 3 p. m., arriving at Portland 5 p. m., and leaving Portland 5:35 p. m., arriving at Rainier 7:25 p. m.

The total distance for the four single trips per day is 183.2 miles. The gas-electric motor car will be required to haul regularly one 25-ton trailer, seating 60 passengers. At times, when traffic is heavy, it may be necessary to haul two trailers of this capacity on both round trips. The schedules of trains composed of the motor car and two trailers will be increased 10 minutes each run, with stops of not more than 30 seconds. The maximum grade on this section of the railway is one-half of one per cent, extending over a distance of about 3 miles; but, in general, the road follows the Columbia river grade and is nearly level.

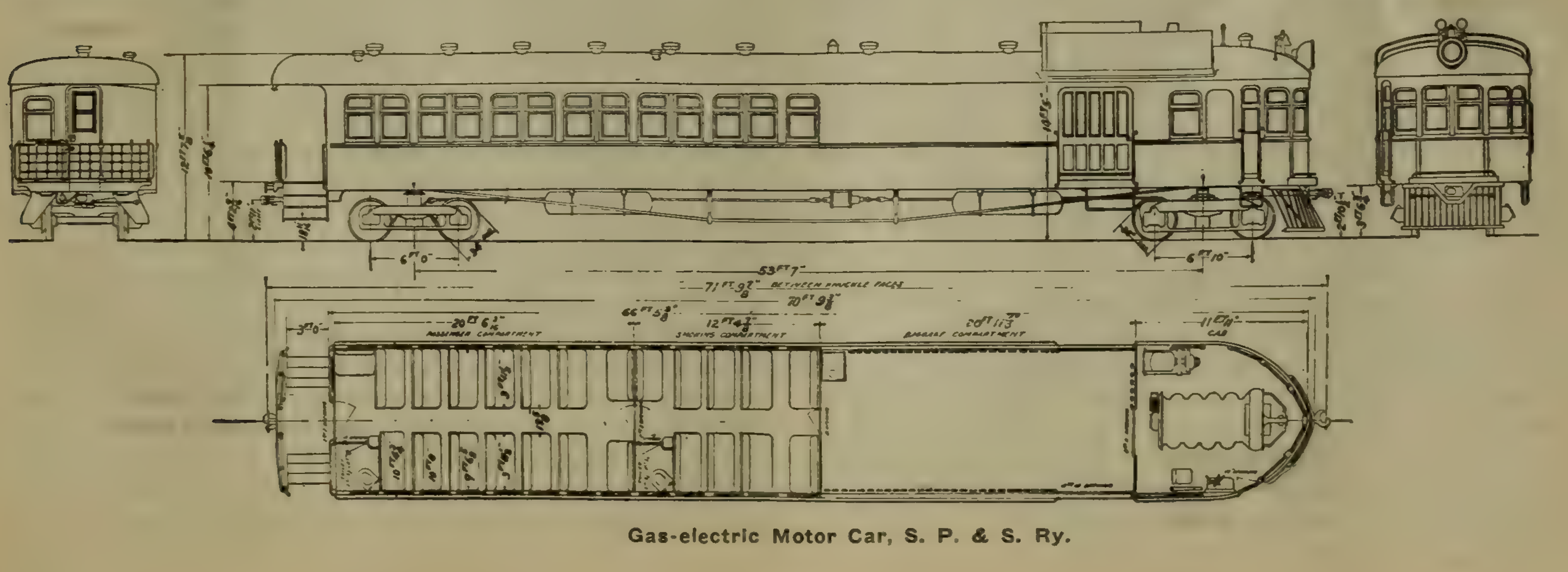
The Spokane, Portland & Seattle Railway runs from Spokane, Wash., through Portland, Ore., to Warrenton, Fort Stevens and Holladay on the coast. It connects with Seattle, Wash., over the Great Northern Railway and the Northern Pacific Railway. Other connecting lines are the Oregon Trunk Railway, Oregon Electric Railway and the United Railways. The road embraces a total of 556 miles, standard 4-foot, 8½-inch track gauge. The rolling stock equipment comprises 69 locomotives, 98 passenger cars and 740 freight and miscellaneous cars.

The gas-electric motor car for this railway is what is known as type RE-70-B-21. The details of construction conform in general to those of the standard cars manufactured by the General Electric Company. It will be noticed, however, that the baggage room in the car is about twice the usual length in order to transport the large quantity of express handled, particularly the heavy shipments during the fruit season.

The specific dimensions of the car are 70 feet 11⅜ inches over bumpers by 10 feet 6⅜ inches wide over all. It weighs approximately 51 tons and has a seating capacity for 68 passengers. The interior is partitioned into four compartments. The cab in front, containing the power plant apparatus, measures 11 feet 11 inches long; next is the baggage room, 20 feet 10⅞ inches long; then the smoking section, 12 feet 6 inches long; and the passenger compartment, 20 feet 5⅞ inches long.

The car is equipped with two CB-205, 600-1200 volt, box frame, oil-lubricated, series, commutating pole railway motors having a total of 200 horsepower capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. They are insulated for 1200 volts so that they may be interchanged, if desired, with the motor equipments on the cars of the Oregon Electric Railway, which operates on the 1200-volt system. The generating unit consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct-connected to a 600-volt, commutating pole electric generator, designed to meet the special conditions the service demands.

The body of the car is of the all-steel type of construction, except the seats and interior finish, which is of mahogany. A rear open platform entrance with body and platform railings is provided. The bearings and treads and flanges of the wheels conform to MCB standards. The trucks are of the heavy spring bolster type with elliptic bolster and coil equalizer springs.



Gas-electric Motor Car, S. P. & S. Ry.

HOW TO USE THE TECHNICAL JOURNAL.*

In 1880, the engineer treasured and indexed almost every scrap of printed matter on any engineering subject that came his way. Today his task is to sort out, discard and eliminate that which he can no longer use, and limit himself to the inspection and reading of that which bears principally on his selected professional specialty.

That we cannot keep abreast of the times without reading the engineering journals is obvious. That if we carefully read all the engineering journals in our chosen specialty we would have no time left to earn a living is easily capable of demonstration. What, then, is the proper attitude to adopt toward this ever-increasing flood of information that pours in upon us so relentlessly?

SUBSCRIBERS' ATTITUDE TOWARD PAPER.

If we look about us to see how our fellow engineers solve this matter we shall find a great variety of attitude toward the problem. Some engineers simply do not take engineering journals, reading one occasionally here and there as opportunity offers. Others take all they can afford to take and let them pile up around the office, often unopened and unused. Others still limit themselves to a select few, which they carefully bind and shelve. Still others read journals when they can, and throw them away when they move on. As a rule, however, the engineer prizes his technical paper, and endeavors in some ill-defined and formless sort of fashion to preserve its information for future use. Generally he fails to find any practical scheme which makes his rapidly accumulating material of much value to him after it has once passed under his eye, and for a large number of engineers technical journals are only professional newspapers with which to idle away an hour or so and satisfy their curiosity. That their value is something much more than this, or should be more than this, is so apparent as to need no denial.

The problem of the engineer with his technical paper is much affected by his age, station and aim in life. To the man who is engineering only to get money and more money, the engineering journal is a newspaper, in which he may notice mainly where there are better jobs than his own that may be sought after and perhaps obtained. To the man who is anxious to fit himself every year of his life for something better it is an opportunity, quite unequaled many years ago, for a great variety of study. To the young engineer the engineering journal, properly read and noted, is a part of a post-graduate course in engineering. To the middle-aged man it is a mine of data, bearing in all sorts of ways on his work; and to the mature specialist only does it begin to become burdensome by its repetition of experience, and its volume of matter on subject which has already, to him at least, been well digested. Let us see if we can outline how each of these classes can get more profit out of the matter contained in the engineering journals than do the careless or the indifferent, who, after their journal is once looked over, let it go to waste or idleness.

PROBLEM OF YOUNG ENGINEER.

The young engineer and the college graduate need, most of all, practical experience. It is safe to say that engineering literature will never have any proper perspective for him until he has been connected in some capacity with engineering work himself, be it in ever so modest a capacity. With the actual doing of engineering work, however, should come contemporaneously the reading of technical journals, particularly along the lines in which he is working. Nothing can be more instructive, broadening, and enlightening to a man doing a particular kind of work than reading about similar work at the same time. It follows, therefore, that the young engineer should, as early as possible, take at least one first-class engineering journal and own it himself; bind it if he can afford to, but lay it away in an orderly manner, in any event. If he can afford two journals so much the better.

It is to be doubted if laborious reading of all kinds of engineering articles all the time is advisable for anyone. Mere quantity of reading is mentally detrimental. If one might advise, it would be to suggest enforced systematic reading of all articles particularly bearing on the line of work the reader is immediately engaged upon, and the optional reading only of such other articles as interest him. This ought not to be much of a task. In course of time as his experience broadens, engineering reading will become less burdensome and more interesting because its relation to practical matters will be more and more appreciated, and the discriminating use of engineering literature better understood. Of course, all this applies to engineering societies as well; but that is another story.

It is probably not wise for the young engineer to indulge extensively in card indexes, filing systems, and the like, for topically arranging his available engineering journal articles. Few men know very early in life where fate and interest will land their future attention, and filing systems and special indexes are expensive and time consuming, and when indulged in without definite aim nearly always quickly become too voluminous and thereby useless. If any suggestions are made along this line, it would be to start a loose leaf, letter size (8½-inch x 11-inch page) notebook and note in it (separate pages for separate subjects) only what appears to be extremely useful, either in exceedingly brief abstracts from articles, or diagrams and costs.

The young engineer is tempted to read much about large enterprises—the Panama Canal, big bridges, astonishing tunnels, great dams. This does no harm, and probably holds his interest for the time being. Gradually he learns that, for him at least, the chief value of the technical journal does not lie in its dramatic side, necessary as that may be for our general information, interest and pleasure, but its chief value lies in a fund of small things, which make up routine work of the ordinary every-day job. These are to be watched for, and noted, as practically useful to the average man.

THE MIDDLE-AGED READER.

We next come to the man in early middle life, actively engaged in his profession, and note at once that his problem with the technical journal is the absence of "time." Absorbed in a multitude of responsibilities, harassed with unexpected difficulties, worn out at night with the long day of strain, how shall he derive any useful good from the multitude of journals which his more ample income can readily afford, but which pile high on his table after every brief absence from the office? Whether or no such an engineer shall make any effort systematically to assimilate, file, and study current technical journals depends in part upon the nature of his routine. If he is largely engaged in administrative work, or is a salaried officer in a large enterprise with a comparatively limited range of problem or a limited call for miscellaneous data, he may generally be content with a cursory examination of the engineering journal such as will keep him qualified on his undertaking, and the preservation of such journals in bound form, with the standard published indexes. If, however, he is entering upon novel work, or work presenting a great variety of problems, overlapping into a great variety of fields, ambition will compel him to do more than this, and some form of special indexing will appeal to him more or less strongly as he feels the need more often for research in up-to-date material.

The average editor can judge of a technical article with only a brief inspection—a sentence here and there, a headline, and a moment's reading of the summary and conclusion. Long familiarity with matter of a similar character gives him the assurance that he can detect in this rapid review anything novel, new, or original, and can fairly pass judgment upon it in a general way. The working engineer who has had some experience with technical literature can form the same habit, and save much time. It is really wonderful how much repetition there is in engineering writing and in the production of engineering papers. It thus happens that we are under the necessity of seeing much the same facts and principles repeatedly published in varying form, for some one is always attracted to really read them, with consequent benefit to himself, under the belief that they are new and novel.

*Abstract in the *Electric Railway Journal* of a paper presented by John W. Alvord, consulting engineer, Chicago, at the Convention of the Federation of Trade Press Associations, Chicago, September 24-26. While this is from the viewpoint of the professional engineer, it contains many hints of value to the railway man.

The mature engineer notes that a large amount of engineering literature is of the purely descriptive order, merely giving outline of work that has been accomplished without going into reasons or principles. All this kind of writing is valuable and useful, and has its proper place, but all of this class of literature has its limitations. One of the most severe of its limitations is that it rarely describes mistakes, errors of judgment, or failures, and in these lie the most valuable lessons to the seeker after truth. One is obliged to read between the lines or read with reservation, much as one does in reading accounts of battles in the daily press. It is always wise to look back and note the origin of the dispatches in such cases.

A tremendous lot of engineering literature is written which is of little permanent value. Often it represents the writer's struggles to understand a subject. Often it is compiled largely from a desire for publicity. Fortunately the editors of the technical papers can limit this kind of reading by care in selection.

SEPARATING WHEAT FROM CHAFF.

But amid all these drawbacks a discriminating mind will always find a great deal of wheat amid the chaff, and the wheat that will be gleaned will be of differing kind and amount, depending upon the type of mind of the reader, his present problem, and his desire to systematize his information. What, therefore, shall he do with his special selection when once he thinks he has separated it from the flood of raw material?

Several courses are open to him:

First, he may rely on his memory and the published index to his bound volumes. It is safe to say, however, that few engineers really make much practical use of this method. The intervening index and the bother of a search prove to be discouraging to that degree that a proposed reference search is abandoned in about one-half the suggested attempts. The ideal filing system is one in which, with the least amount of effort, one can put his hand immediately and accurately on the thing itself, be it a book, pamphlet, or a data sheet.

Second, he may keep a special card index of important data and reference to valuable articles. This at once involves labor and attention which few busy men can give and which, if done by assistants or librarians, largely loses its personal value to the one who needs it. The same objection as to the discouraging effect of intervening indexes holds good here, too, and it is further safe to say that of all the contrivances for indexing the most difficult to handle readily and examine rapidly is the card index system.

Third, he may abstract important data in a limited way on loose-leaf transparent paper, standard letter-size, and he may remove or detach articles of special value from out his journals, to be filed in regular office file system, like correspondence.

The writer has tried all of the above methods at considerable cost in time and patience, and has, for many years, settled upon the third method. With all its admitted limitations it seems to be the best for an office which is expected to find out information on a great variety of subjects in a limited time, and with the least amount of effort.

THE MATURE ENGINEER.

We come finally to the mature and experienced engineer of advancing years. How can he make engineering and technical literature of use? It is safe to say that when an engineer has much passed fifty or sixty years of age and has led an active life, his need for engineering literature lessens. Out of the mass of detail which seemed to him so overwhelming and endless in his youth and early manhood, fundamental principles emerge like peaks out of the clouds, and upon these as foundation all detail classifies itself simply and naturally, and therefore he feels less need for accumulated data or particular description. Probably no one enjoys engineering reading as does the mature engineer, for he can read between the lines and find much to instruct as well as interest, and yet while he is probably the most interested and intelligent reader of engineering literature that the journals have, his ambition as a collector is gone and filing systems no longer appeal to him.

If his acquaintance is wide, he reads with interest the accomplishments of his friends, and the addresses of society presidents and articles on the ethics of the profession. Of failures he is the keen student. The personal column appeals to him, and if he is of rightmindedness he is conscious of more pleasure than formerly in the accomplishments of those who have succeeded and succeeded well in dire and burdensome responsibility. More often than the young man he will turn back for his satisfaction to papers that served him well in times past, and perhaps smile at the lack of improvement that later attempts to deal with their subject often show.

Technical papers, along with the technical societies and their proceedings, form the repository of the professions; they are the interchange of experience, the common store upon which we all draw. Without them we would be strangely helpless. We are more or less indebted to everyone who records his experience for the common use, and that debt we should endeavor to helpfully repay in kind, but wisely, concisely and thoughtfully.

SPRING SWINGING LINK.

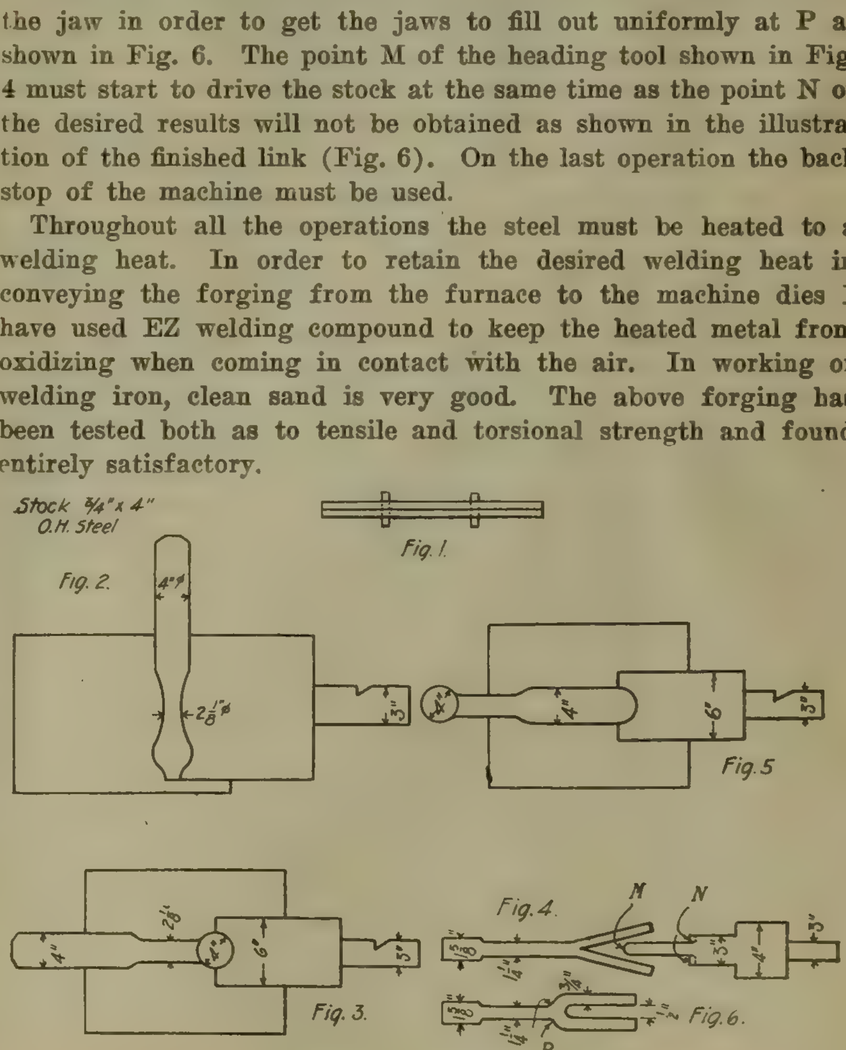
By Paul H. Cain, C. C. C. & St. L. R. R., Beach Grove, Ind.

The illustration shows the manner of making a Pullman or motor truck swinging link on a forging machine. This is made of open hearth steel. Fig. 1 shows the material prepared for the dies and sheared to a length with enough material for two links, thus enabling the operator to do without the aid of tongs. Holes of $\frac{13}{16}$" diameter are punched and ¾" round iron is used for rivets. The stock size is ¾"x4". Two heavy strokes under a steam hammer rivets the two pieces together, giving for the first operation a bar size of 1½"x4". The stationary die and the heading tool form and weld the spring plank bearing head, the material being dropped into the die in a vertical position and formed as shown in Fig. 2.

Fig. 3 shows the finishing or shaping die. The work is put into these dies from a horizontal position. This illustration shows the heading and stationary die, the machine stroke having gone to its full length, thus finishing the second operation. Fig. 4 shows the link jaw and heading tool on the third operation. Fig. 5 shows the link jaw and heading tool in the stationary die and the finished link is shown in Fig. 6.

Precaution must be exercised in the amount of stock used in the jaw in order to get the jaws to fill out uniformly at P as shown in Fig. 6. The point M of the heading tool shown in Fig. 4 must start to drive the stock at the same time as the point N or the desired results will not be obtained as shown in the illustration of the finished link (Fig. 6). On the last operation the back stop of the machine must be used.

Throughout all the operations the steel must be heated to a welding heat. In order to retain the desired welding heat in conveying the forging from the furnace to the machine dies I have used EZ welding compound to keep the heated metal from oxidizing when coming in contact with the air. In working or welding iron, clean sand is very good. The above forging has been tested both as to tensile and torsional strength and found entirely satisfactory.



Spring Swinging Link.

The method of making machine forgings and their efficiency has been somewhat of a question among forge shop foremen. However, at present, the forging machine is progressing far beyond any equipment on the market. My own experience and recent tests taken on forging machine forgings convinces me of this.

DAIRY CARS, B. & O. R. R.

Advanced steps in the interest of public health have been taken by the Baltimore & Ohio with the placing of four modern and sanitary dairy refrigerator cars in service to handle milk daily between points in Ohio and the Pittsburgh market.

The new cars which were built in the Mount Clare shops, at Baltimore, according to specification approved by the United States Department of Agriculture, will insure the arrival of milk in Pittsburgh at a temperature of forty-five degrees from the creameries at Ravenna, Newton Falls, Chardon, East Claridon, West Farmington, Painesville, Chicago Junction and intermediate points after a run of five hours. All possibility of the growth of bacteria while milk is in transit is removed, health authorities and railroad officials stating that the new cars will retain their uniform temperature for forty-eight hours with but one icing when the thermometer registers ninety degrees.

The interior finish of the cars is of white enamel, affording every precaution against the harboring of germs and in harmony with the general cleanly appearance. In appearance the cars are the same type as postal cars, being sixty feet long and so constructed as to provide practically hermetical sealing, which is essential in the hauling of milk for long distances from dairy regions to central markets.

"Milk Refrigerator" is lettered on their sides in gold leaf. The cars have double floors of yellow pine and are covered with "flexolith," the most improved sanitary floor covering in use. The material permits of a thorough flushing of the cars in cleaning the equipment.

The cars are designed for brine refrigeration and represent the highest development in scientific refrigeration of milk. In each end are ice bunkers, extending from floor to roof, containing six brine tanks in which are carried ice and salt. Two bulkheads five inches thick with refrigerator doors, are built across the cars on each side of the center doorways, thus creating two cold storage compartments with a floor space of 176 feet each and with capacity for thirty ten-gallon cans.

It was the result of prolonged effort by the Department of Agriculture that every safeguard be taken for the protection of milk from deterioration en route which suggested the new cars. The practice of dealers is to pre-cool before loading, so that the new cars will be saved a change in temperature and bacterial growth will be prevented.

The average haul of milk to the Pittsburgh market is 130 miles, from points in northern Ohio, but the possibility of contamination while in the new-design cars has been removed. Experts from the Department of Agriculture are showing keen interest in the new equipment, and it is likely that the specifications will be adopted as the standard in the future construction of dairy cars. Daily records of the temperature are being taken, together with data as to the quantity of ice consumed and other information bearing on changed conditions in dairy product transportation through the advent of the new cars.

Before the cars were put into service, they were opened for public inspection and were visited by health authorities, physicians, milk dealers and representatives of the press. The cars are in regular service between Chicago Junction and Pittsburgh, at which points icing stations have been established. They are expected to make a round trip before being repacked and will arrive in Pittsburgh from Chicago Junction and Painesville on train No. 10, at 10:10 p. m.—*B. & O. Employees' Magazine.*

The Chicago & Alton is building an eight-stall roundhouse and a small machine shop and power house at Brighton Park, Ill. The buildings are of concrete and brick construction.

JACK, THE TIME KILLER

There's a prospect to see in the morning;
But before Jack attempts any work,
He settles the war for an hour or more
In a talk with the telephone clerk.
He looks at a couple of letters,
And sketchily skims through the news,
And says that the dope bears out his fond hope
That the Giants are going to lose.

He goes out to luncheon at noontime,
And sits 'round and puffs a cigar,
While he stoutly contends to a couple of friends
That this fighting is going too far.
He is back on the job at two-thirty
And sticks till a quarter past four,
Then he strolls to the board where the tallies are scored
And "fans" for a full hour or more.

At his home or hotel in the evening
He plans out the Russian campaign.
He tells all the bunch of his newly born hunch
That the plans of the Allies are vain.
He sits 'round till bedtime deploring
The prices of foodstuffs and cotton,
Then he climbs into bed, wearied out and half dead,
And wonders why business is rotten!

—*Author Unknown.*

Personals

WILLIAM HARRISON succeeds William Deveny as general foreman of the *Atchison, Topeka & Santa Fe* at Newton, Kan.

M. W. ROLOSON succeeds E. P. Gray as general foreman of the *Atchison, Topeka & Santa Fe* at Arkansas City, Kan.

B. A. ELDRIDGE succeeds K. S. McCune as general foreman of the *Atchison, Topeka & Santa Fe* at Chillicothe, Ill.

H. GALLAGHER succeeds A. F. Reeves as road foreman of engines of the *Atchison, Topeka & Santa Fe* at Chicago.

B. P. PHELPS has been appointed engineer of shop extension of the *Atchison, Topeka & Santa Fe,* with office at Topeka, Kan.

W. D. HARTLEY succeeds A. G. Cunningham as foreman of the *Atchison, Topeka & Santa Fe,* Coast Lines, at Barstow, Cal.

S. C. DOWS succeeds R. S. Cook as purchasing agent of the *Cedar Rapids & Iowa City,* with office at Cedar Rapids, Ia.

E. A. EVERHART has been appointed master mechanic of the *Charles City Western,* succeeding A. L. Ellis. His office is at Charles City, Ia.

A. J. EICHENLAUB succeeds J. B. Rogers as general foreman of the *Chicago & Eastern Illinois* at West Frankfort, Ill.

O. E. SHAW succeeds H. G. Love as general car foreman of the *Chicago & Eastern Illinois* at Danville, Ill.

L. CHAPMAN has been appointed assistant master mechanic of the *Chicago & North Western* at So. Pekin, Ill., succeeding C. D. Ashmore.

C. D. ASHMORE succeeds L. Chapman as foreman of shops of the *Chicago & North Western* at Chadron, Neb.

J. O. MCARTHUR has been promoted to master mechanic of the *Chicago, Burlington & Quincy* at Casper, Wyo. He was formerly assistant master mechanic at this point.

A. G. PIERCE succeeds J. L. Brandt as general foreman of the *Chicago, Burlington & Quincy* at Edgemont, S. D.

D. C. MCCARTHY succeeds J. O. Lasswell as traveling engineer of the *Denver & Rio Grande,* with office at Salida, Colo.

A. G. TITUS succeeds D. C. McCarthy as traveling engineer of the *Denver & Rio Grande* at Grand Junction, Colo.

F. KINZEL succeeds D. Swineford as general foreman of the *Detroit, Toledo & Ironton* at Delray, Mich.

E. L. MAUK succeeds P. G. Clark as superintendent of motive power of the *Georgia, Florida & Alabama*, with headquarters at Bainbridge, Ga.

W. H. SAMPLE has been appointed master mechanic of the Western lines of the *Grand Trunk*, succeeding G. Vliet, deceased. His headquarters are at Battle Creek, Mich.

G. MARKEY has been appointed master mechanic of the Ontario lines of the *Grand Trunk*, with headquarters at Toronto, Ont.

G. R. DONNELLEY has been appointed assistant master mechanic of the Ontario lines of the *Grand Trunk*, with headquarters at Allandale, Ont., and the title of master mechanic of the Northern division has been abolished.

T. MCHATTIE has been appointed master mechanic of the Eastern lines of the *Grand Trunk*, with headquarters at Montreal, Que., and the title of master mechanic of the Ottawa division has been abolished.

E. R. BATTLEY has been appointed general foreman of the *Grand Trunk* at Deering, Me.

T. W. CALLAHAN, master mechanic of the *Great Northern*, has been transferred from Whitefish, Mont., to Minot, N. D.

J. DELANEY, master mechanic of the *Great Northern*, has been transferred from Minot, N. D., to Whitefish, N. D.

H. F. STAPH succeeds D. P. Phalen as locomotive foreman of the *Great Northern* at Butte, Mont.

FELIX GAGNON succeeds J. M. Bourdeau as roundhouse foreman of the *Intercolonial* at St. Flavie, Que.

G. W. TAMSITT has been appointed acting master mechanic of the *Kansas City, Mexico & Orient of Texas* succeeding Charles Woodard. His office is at San Angelo, Texas.

W. J. MILLER succeeds the late T. E. Adams as superintendent of motive power of the *St. Louis Southwestern*, with headquarters at Pine Bluff, Ark.

P. G. NELSON has been appointed general foreman, car department, of the *San Antonio, Walde & Gulf*, with office at Pleasanton, Tex. He succeeds A. F. Hawkins.

OBITUARY.

FRANKLIN W. CHAFFEE, general car inspector of the *New York Central & Hudson River*, has passed away since the recent convention of the Chief Interchange Car Inspectors & Car Foremen's Association. Mr. Chaffee was born at Springfield, Mass., December 17, 1850. He commenced railroad service about 45 years ago in the car department of the Boston & Albany and later went to the Baltimore & Ohio at Baltimore, Md. About thirty years ago he was appointed general car foreman of the car department of the New York Central & Hudson River, at Albany, N. Y., and soon after was made master car builder. On January 1, 1901, he was appointed general car inspector of the New York Central & Hudson River, which position he held until death. Mr. Chaffee was a man of fine character, conscientious, and loyal in his support of his employers. His efforts and ambition were untiring and those who came in contact with him in business know of his fairness and honesty. His associates have lost a valuable friend and co-worker, and deeply mourn his loss.

CHARLES J. DRURY, master mechanic of the *St. Louis & San Francisco*, at Sapulpa, Okla., died of typhoid fever, on September 30. He was a son of M. J. Drury, superintendent of shops of the Atchison, Topeka & Santa Fe, at Topeka, Kan. Mr. Drury was 36 years of age and was born at Chicago Junction, Ohio. He commenced railway work in July, 1895, as machinist apprentice for the Atchison, Topeka & Santa Fe and afterwards was employed as machinist for the Santa Fe, the Southern Pacific, the Kansas City Southern, the El Paso & Southwestern, and the Chicago, Rock Island & Pacific. He was appointed roundhouse foreman for the Santa Fe at La Junta, Colo., in July, 1906, and remained with the Santa Fe in various positions until February, 1913. He then became master mechanic of the St. Louis & San Francisco at Ft. Smith, Ark., and the following February was appointed superintendent of shops at Springfield, Mo. He was promoted to division master mechanic at Sapulpa, Okla., on September 1.

New Books

AMERICAN MACHINISTS' HANDBOOK. By Fred H. Colvin and Frank A. Stanley, associate editors of the *American Machinist*. Leather, 7x4 inches, 673 pages, fully illustrated. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York, N. Y. Price, $3.00.

This is the second edition of this handbook and in addition to adding one hundred and sixty pages to the book, the authors have carefully revised every section and brought the whole work down to date. The book is intended for the man who is interested in the details of shop practice, whether he be in the shop itself or in the drafting room. It contains some matter which every foreman or draftsman knows, but this is necessary in order to make it a comprehensive machinist's handbook. However, no man can keep in his mind the mass of data and information relating to his own particular work and herein lies the value of this volume. It contains complete information on all subjects in which the machinist, his foreman, and the draftsman are interested and the authors have recognized the wisdom of providing a thorough index, one of the most essential features of a book of this sort.

In a number of instances the results of tests and the best practices of well-known manufacturers are reviewed, as in the chapter on reamer and cutter grinding. This has been done with a view of giving the reader the benefit of the work of the manufacturer in short concise form that he may have at hand all the best data on the subject. To illustrate the character of the matter: the chapter on gearing covers 43 pages and by means of line drawings, descriptive matter, and tables, gives complete information by which the draftsman can lay out spur gears, bevel gears, spiral gears and worms. The chapter on screw machine tools, speeds and feeds, touches on hollow mills, dies and taps, forming tools, how to find the diameter of circular forming tools and hardening spring collets. There is a chapter of 63 pages on that important subject, "Milling, and Milling Cutters," explaining the action of the milling cutter, giving tables of pitches and angles, tables for milling screw machine cams, indexing, etc. At the rear is a valuable feature,—a 92 page section devoted to a dictionary of shop terms, which is also very fully illustrated. The volume is a good one and is what it claims to be—an American machinist's handbook.

CAR INTERCHANGE MANUAL. Paper covers, 6x9 inches, 150 pages. Compiled and published by J. D. McAlpine, Cleveland, O. Price, 50 cents.

This volume is, as stated in the foreword, a compendium of useful information for master car builders and car inspectors. It contains first an abstract of all decisions of the arbitration committee from case one to case 966. The second section is a car interchange guide and contains reference tables giving price lists for couplers, wheels and axles, and journal bearings. Various miscellaneous costs are given, such as the cost of material for flooring and the labor for applying. Several pages are devoted to prices, scrap value, material and net charges on metal brake beams and parts. An index of M. C. B. rules and decisions on air brakes, journal bearings, and so on is given. The volume is a very useful one to car men in general and particularly to car inspectors and repairers, who will have constant use for the information contained.

A STUDY OF THE OXIDIZATION OF COAL. By H. C. Porter and O. C. Ralston. Paper covers, 6x9 inches, 30 pages. Technical paper 65 issued by the Bureau of Mines, Department of the Interior, Washington, D. C.

This paper treats of the absorption of oxygen from the air by coal and gives the results of investigations by the Bureau of Mines on the escape of gas from broken coal. The rate of oxidization was obtained on samples of coal from Sheridan county, Wyom-

ing, Franklin county, Illinois, Washington county, Pennsylvania, and Fayette county, West Virginia. In the conclusions it is stated that the rate of oxidizability varies approximately as the percentage of volatile matter and that the tendency of coals to deteriorate in storage or to develop heat spontaneously conforms to their relative oxidizability. The paper is of especial interest to fuel engineers.

OCEAN TRAFFIC AND TRADE. By B. Olney Hough, Editor The American Exporter. Cloth, 6x9 inches, 430 pages, illustrated. Published by the LaSalle Extension University, Chicago. Price $3.00.

Nine-tenths of our foreign trade is carried by water and it amounts to over two billion dollars yearly. This in itself, says the author, justifies a treatise on ocean traffic and trade. The title indicates accurately the subject matter of the book and its treatment is most complete. To shippers and to manufacturers especially the book contains a great deal of good information and to those interested in transportation generally it is a very readable volume. The opening chapters deal with the various classes of steamships and service, tonnage, ship regulations, seaport facilities and ocean shipping routes. There is a long chapter on charters and ocean freight rates, a chapter on shipping agreements and two chapters on handling import and export shipments. The subject of marine insurance is also gone into quite extensively. The concluding chapters are devoted to the finances of shipping companies, getting foreign business, developing export trade, and foreign loans and collections. The last chapter is entitled "America's Opportunity in the Markets of the World," and was written especially with regard to the influence of the European war on foreign trade.

The book is illustrated with photographs and a large number of reproductions of various forms used in foreign shipments. The author has made the book a practical shipping guide and has made especial efforts to set the shipper right on the matter of handling foreign freight. The volume is of interest to everyone and is especially to the point at this time, when Americans are begining to realize what ocean traffic and its interruption means to this country.

Among The Manufacturers

ROTARY AIR COMPRESSOR.

At the recent exhibition of foundry appliances in Chicago a rotary air compressor of unusual interest was shown. The size exhibited has a displacement of 85 cubic feet per minute, and in single stage, pressures up to 100 pounds per square inch can be delivered. The speed is approximately 400 r.p.m. The compressor weighs only 1,400 pounds without its sub-base, is 46 inches long, 35 inches high and 28 inches wide.

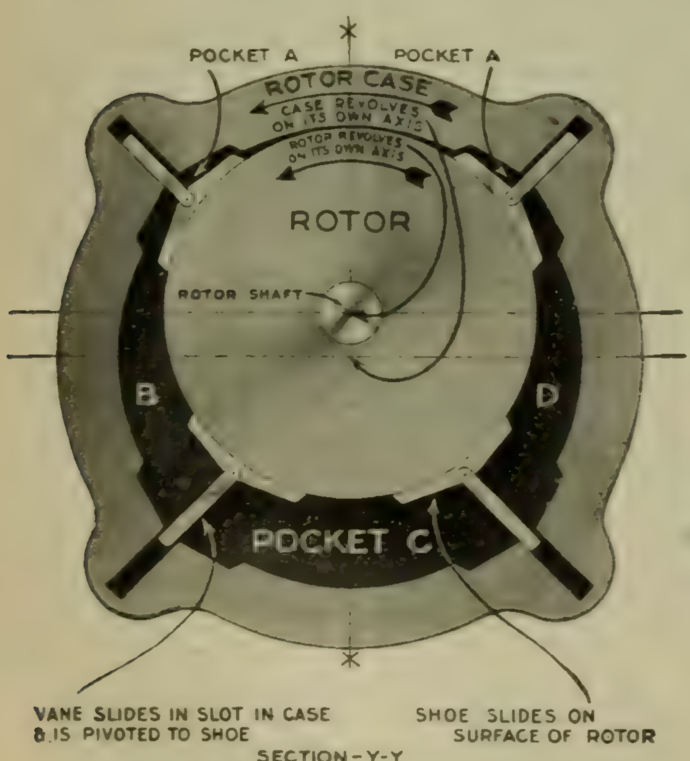
The illustrations show the mechanism but the movement of the parts is not easily understood without study. Both the case and the rotor revolve at the same speed and in the same direction, but on different centers. In each of the pockets shown in the cross-section an intake and a discharge valve are located. These valves connect through suitable passages in the rotor and the hollow rotor shaft.

One of the greatest advantages of this compressor is the ease with which effective cooling can be maintained. The heat of compression is practically eliminated at its source by radiation. The outer wall of each pocket gives a radiating surface very large in proportion to the volume of air compressed. Furthermore, the effective cooling area is constant, not reduced during compression. The entire outer surface of rotor case, revolving at high speed and constantly exposed to fresh air, forms the effective cooling area. The discharge temperature does not exceed 300 degrees when the intake temperature is 60 degrees.

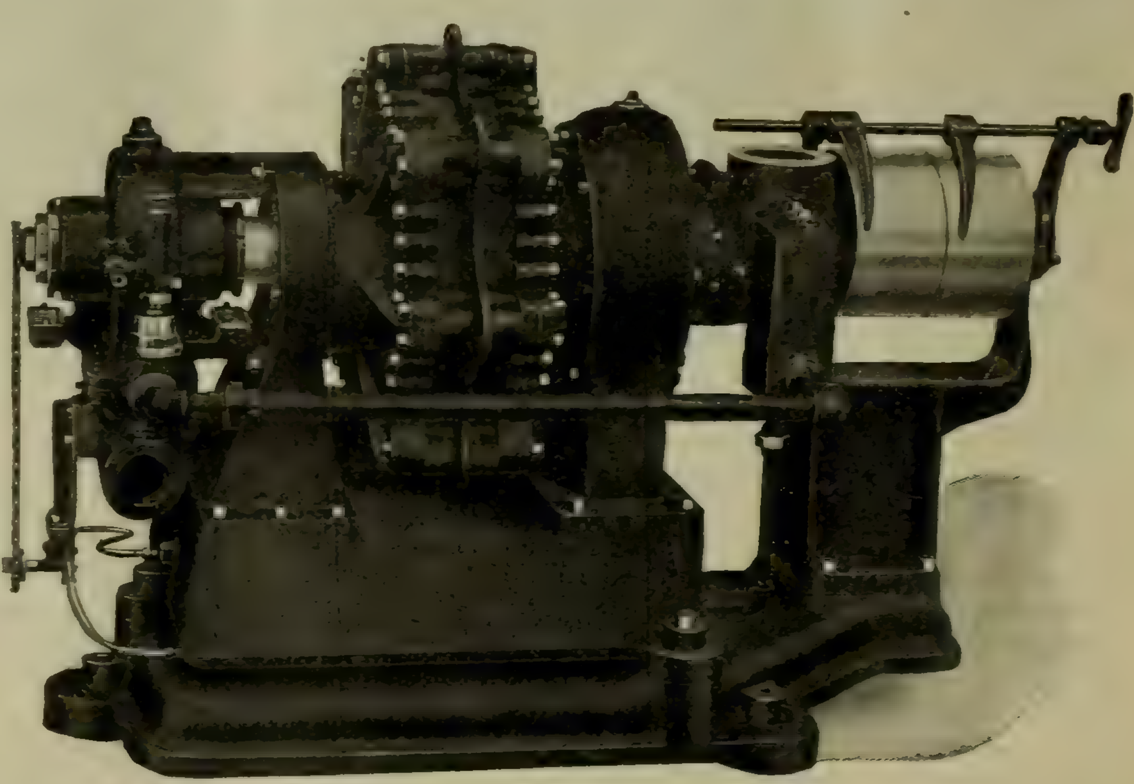
Sealing of the air in rotary compressors has been a difficult problem, but is effectively obtained by simple means in this design. During compression the pressure in the leading pocket is always greater than in the following pocket, and it presses the vane against walls of the slot, preventing back leakage. The rotor and case revolve in the same direction and at the same speed, without side thrust. The small relative motion and slow relative speed permit a close sealing fit on the side walls, without undue friction.

The compressor is smooth running and low in power consumption. It may be driven by belt or direct-connected motor, and is efficient at all speeds up to the maximum. It is automatic in action and requires little attention.

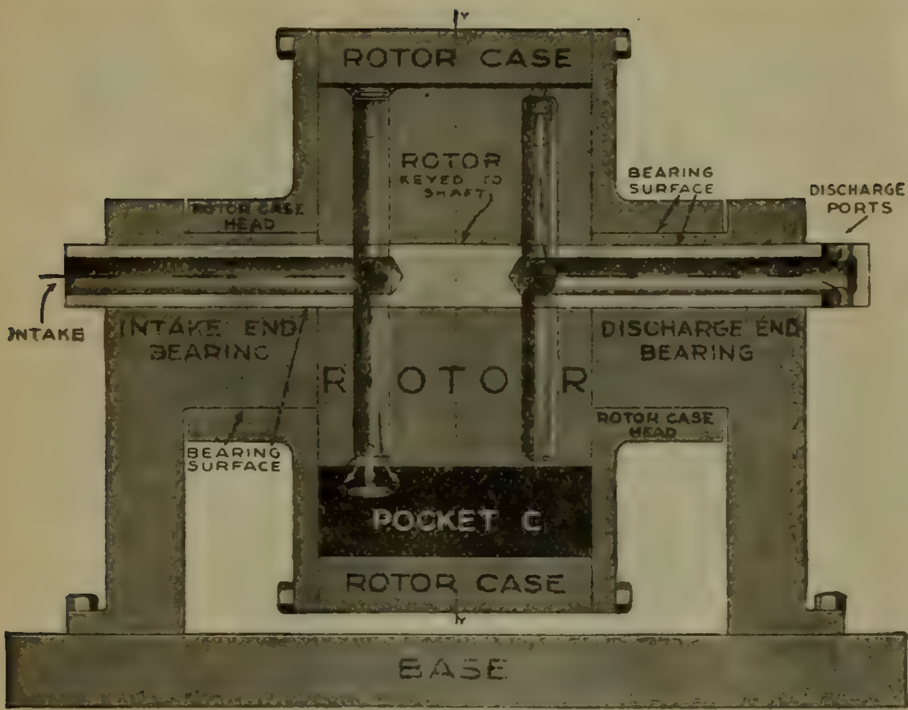
The machine is made by the Wernicke-Hatcher Pump Co., Grand Rapids, Mich.



Transverse Section Through Rotor and Case.



Single Stage Rotary Compressor.



SECTION-X-X

Longitudinal Section Through Rotor, Rotor Case and Hollow Shaft.

HAUCK KEROSENE TORCH.

A kerosene torch of novel design has been placed on the market by the Hauck Mfg. Co., of Brooklyn, N. Y. It was especially designed to take the place of the gasoline torch.

The most important feature is the construction of the bronze burner. The oil passage ways are especially large and so arranged that only one plug has to be unscrewed in order to clean the whole burner instantly. By a special oil regulating valve the flame can be adjusted to any size from 8" long by 1" in diameter to the finest point.

As kerosene contains more heating units than gasoline, the temperature obtained with this torch is much higher than that of

Hauck Kerosene Blow Torch.

the gasoline torch, which makes it especially suitable for brazing machine parts, cables, wires and pipes, preheating bearings before babbitting, thawing out pipes, burning off paint, annealing, tempering and dressing tools.

It is also claimed that strong wind or cold weather will not effect the flame in any way and it is therefore especially recommended for outside work.

The torch is also furnished in connection with a light furnace mended for outside work. The torch is also furnished in connection with a light furnace for melting solder and heating soldering coppers.

The Western sales territory for the torch is in charge of Willis C. Squire, vice-president and general manager, Western Union building, Chicago.

New Literature

The Lutz-Webster Engineering Co., Philadelphia, Pa., has issued Bulletin No. 4, giving descriptions and prices of Lutz compression tools, including drill posts, drill sockets, ratchets and wrenches.

* * *

Circular No. 53, of the National Malleable Castings Co., Cleveland, O., describes and illustrates malleable iron fire shovels, used for caboose car stoves, depots and section houses.

* * *

The Smooth-On Mfg. Co., Jersey City, N. J., has issued a booklet on "Smooth-On for Foundrymen," telling of the difference between Smooth-On castings No. 4, grade A and B. A folder has also been issued on iron cement No. 7, for concrete construction.

* * *

The Ingersoll-Rand Co., 11 Broadway, New York, has issued form No. 8207 on "Little David" drills, for metal and wood boring, and form No. 8013 on "Little David" pneumatic chipping, calking and scaling hammers.

* * *

The Westinghouse Electric & Mfg. Co. issued some elaborate literature in connection with the American Electric Railway Association convention held last month. This included "Railway Exchange Data," "Heavy Traffic Centers," "Train Operation for City, Suburban and Interurban Service," and a "progress" leaflet, showing the progress made by the company in electric railway apparatus during the past year.

* * *

The Railway Appliances Co., Old Colony Bldg., Chicago, has issued an attractive catalogue of the "Ray" snow flanger, for use on locomotives and cars. Full descriptions are also given of various types of snow-plows.

The Selling Side

H. C. Hequembourg, general purchasing agent of the American Locomotive Company, has resigned to accept the vice-presidency of the Standard Chemical Company, Pittsburgh, Pa.

R. Harvey White, southern representative of the Chicago Railway Signal & Supply Company, Chicago, has been promoted to the position of signal engineer of that company.

M. Wuerpel, assistant general manager of the General Railway Signal Company, has been appointed assistant to the president of that company. S. G. Johnson, who was recently elected vice-president, will be in full charge of the sales department, with headquarters at Rochester, N. Y. A department of publicity and education has been created and H. M. Sperry has been appointed the manager.

Horace L. Winslow, president of the Horace L. Winslow Co., has also been elected vice-president of the E. G. T. Colles Co., builders of feed water heaters and steam specialties. The offices have been removed to 990 Old Colony building, Chicago.

The Buda Company, Chicago, Ill., has taken over the repair link for wrecking chains patented by John E. Buckley, former foreman blacksmith of the Illinois Central.

Charles Hyland, formerly foreman boiler maker of the Michigan Central at Jackson, Mich., has been appointed boiler expert for the Flannery Bolt Company of Pittsburgh, to succeed the late Tom R. Davis.

Charles M. Schwab, president of the Bethlehem Steel Company, has resigned as a director of the American Locomotive Company, and Andrew Fletcher has been elected a director to succeed him.

W. E. Jenkinson, who has been western railroad representative of S. F. Bowser & Co., Inc., of Fort Wayne, Ind., has resigned.

JESSE C. BADER now has charge of the western sales branch of the McMyler Interstate Company, Cleveland, Ohio, with offices at 1503 Fisher building, Chicago.

W. T. KYLE has joined the sales force of the Okonite Company and will be located at the general office, 253 Broadway, New York. Mr. Kyle has been connected with the Duplex Metals Company, Chester, Pa., as district sales manager.

F. N. RUMBLEY and J. W. STJERNSTEDT, of the Western Engineering Sales Company, Rialto building, San Francisco, Cal., have been appointed representatives of the Track Specialties Company, New York.

T. B. VAN DORN, first vice-president of the Van Dorn Iron Works Company, Cleveland, Ohio, has been elected president of the company, succeeding his father, J. H. Van Dorn, who died recently.

THE CANTON CULVERT COMPANY, Canton, O., has changed its name to the Canton Culvert & Silo Company.

V. W. ROBINSON has been appointed representative in Michigan for the Independent Pneumatic Tool Company, with headquarters at Detroit. F. J. Passino, the former Michigan representative, has been appointed representative in the Southwest, to succeed H. F. Finney, promoted to a position in the general sales office in Chicago.

H. H. WESTINGHOUSE has been elected president of the Westinghouse Air Brake Company, to succeed the late George Westinghouse.

THE ANCHOR BRAKE & MANUFACTURING COMPANY, Chicago, has been incorporated by Arthur M. Kracke, Edmund P. Kelly and Richard G. Brennan, 209 South La Salle street, to manufacture brake shoes and railroad supplies. Capital stock is $50,000.

THE CENTRAL LOCOMOTIVE & CAR WORKS, Chicago Heights, Ill., has received an order for rebuilding 500 freight cars from the Erie, it is said.

At the annual meeting of the American Locomotive Co. held in New York recently, the retiring directors (W. H. Marshall, A. H. Wiggin and A. W. Mellon) were re-elected to serve for three years. The present officers of the company were also re-elected.

I. H. CASE has resigned as railroad representative of the Dearborn Chemical Company at Chicago.

THE PENNSYLVANIA TANK CAR COMPANY, of Sharon, Pa., is said to be working at full capacity and turning out four tank cars daily.

THE SMITH LOCOMOTIVE ADJUSTABLE HUB PLATE COMPANY, recently reorganized, has elected new officers as follows: A. J. Sams, president; A. H. McCormick, vice-president, and W. G. Wolfe, secretary and treasurer. The offices of the company are at 207 Commerce Building, Pittsburg, Kan.

THE WARNER-REISS SALES COMPANY, St. Louis, Mo., has been succeeded by the Warlic Heater Manufacturing Company. The offices remain at St. Louis, Mo.

OBITUARY.

Tom R. Davis.

TOM R. DAVIS, mechanical expert of the Flannery Bolt Company of Pittsburgh, died at his home in Dravosburg, Pa., on October 12, 1914, after a lingering illness of many months. He was born in Allegheny City, Pa., July 13, 1854, being the only child of the late Capt. Jos. H. and Mary Wallace Davis, and was educated in the public schools of that place. In 1872 he began work as machinist's apprentice with the Allegheny Locomotive Works (now the Pittsburgh plant of the America Locomotive Company). In 1875 he was fireman on the P. F. W. & C. Ry. and the next year was promoted to engineer. In 1877 he entered the employ of the Crosby Steam Gage & Valve Company as special salesman, leaving that company in 1880 to accept the managership of the Monongahela Mfg. Company of Monongahela City, Pa. In 1883 he returned to work for the Crosby interests, leaving them in 1892 to enter employ of the Garlock Packing Company at Pittsburgh as mechanical expert. In 1898 he entered the employ of Homestead Valve Mfg. Company, leaving that company in 1904 to enter the employ of the Flannery Bolt Company as mechanical expert, which position he occupied at the time of his death. He is survived by his wife, Mrs. Mathilda Horner Davis, and three children, Joseph, H. T. Randolph, and Mrs. J. W. McConnell.

JOHN S. PATTERSON, resident manager of the Galena Signal Oil Co. at Cincinnati, Ohio, died at his home in that city on October 13. Mr. Patterson was born in Baltimore, Md., on February, 13, 1839, served his term as machinist's apprentice in the shops of the Baltimore & Ohio at Cumberland, Md., and was later general foreman in the Baltimore & Ohio shops at Portsmouth, Ohio. Later he was appointed master mechanic of the Cincinnati, Indianapolis, St. Louis & Chicago, now the Big Four, at Cincinnati, and served in that position for 25 years. For the past 24 years he had been connected with the Galena Signal Oil Co.

SPENCER VAN CLEVE, president of the Erie Foundry Company, died on September 29.

CHARLES M. GOULD, vice-president and treasurer of the Gould Coupler Company and a son of its president, died on October 20 at his home at Bayside, L. I.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF THE RAILWAY MASTER MECHANIC, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

Railway Master Mechanic is published monthly at 431 South Dearborn St., Chicago, Ill.

The officers are as follows:
President—William E. Magraw, 431 So. Dearborn St., Chicago.
Editorial Director—L. F. Wilson, 431 So. Dearborn St., Chicago.
Editor—O. W. Middleton, 431 So. Dearborn St., Chicago.
Business Manager—C. C. Zimmerman, 431 So. Dearborn St., Chicago.
Publisher—The Railway List Co., 431 So. Dearborn St., Chicago.

Those holding stock to the amount of one per cent or more are as follows:
W. E. Magraw, 431 So. Dearborn St., Chicago.
C. S. Myers, 50 Church St., New York.
H. H. Schroyer, 38 So. Wabash Ave., Chicago.
A. R. Cosgrove, Milwaukee, Wis.
E. C. Price, Springfield, Ohio.
H. U. Morton, 38 So. Wabash Ave., Chicago.
J. S. Bonsall, 26 Cortlandt St., New York.
G. H. Williams, Rockefeller Bldg., Cleveland, Ohio.
P. S. Smith, 434 So. Green St., Chicago.
J. T. McGrath, Boomington, Ill.
L. F. Wilson, 431 Dearborn St., Chicago.
O. W. Middleton, 431 So. Dearborn St., Chicago.
B. H. Peck, Springfield, Ill.

Those holding bonds to the amount of one per cent or more are as follows:
W. F. Hall Printing Co., 446 W. Superior St., Chicago.
Cozzens & Beaton, 443 Plymouth Court, Chicago.
Harry C. Lewis, New York, N. Y.
Geo. H. Holt, 431 South Dearborn St., Chicago.
Myron C. Clark Publishing Co., 612 So. Dearborn St., Chicago.
Mrs. Jessy Hazleton, 446 W. Superior St., Chicago.

(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 18th day of September, 1914.
(Signed) Robert R. Grieg.
(My commission expires Oct. 26, 1915.) Notary Public.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

CHARLES S. MYERS, President C. C. ZIMMERMAN, Business Manager
L. F. WILSON, Vice-President OWEN W. MIDDLETON, Editor

Office of Publication: Manhattan Building, Chicago
Telephone, Harrison 4948

Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765

A Monthly Railway Journal

Devoted to the interests of railway motive power, cars, equipment, shops, machinery and supplies.

Communications on any topic suitable to our columns are solicited.

Subscription price, $2.00 a year; to foreign countries, $2.50, free of postage. Single copies, 20 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to The Railway List Company.

Papers should reach subscribers by the 16th of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

This Publication has a larger circulation than any other among mechanical department officers. Of this issue 4,300 copies are printed.

Entered as Second-Class Matter June 18, 1895, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

Vol. XXXVIII Chicago, December, 1914 No. 12

CONTENTS

Motor Car Dangers

The use motor passenger cars for branch line service on steam roads is becoming quite frequent and an accident which occurred this fall emphasizes the fact that the gasoline which these cars must necessarily carry constitutes a source of danger. Early in August a collision between a passenger motor car and a passenger train occurred on a line of the Kansas City Southern in which forty-three persons were killed and thirty-eight were injured. The report of the chief of the division of safety, Interstate Commerce Commission, states: "This is the first accident investigated by the commission wherein a gasoline motor car was involved. On account of the fire caused by igition of this highly inflammable substance, the casualty list in this accident was much larger than it otherwise would have been. The rapidly increasing use of these motor cars, carrying large quantities of gasoline, introduces such an additional element of danger as to demand extraordinary precautions against the possibility of collisions when such cars are used."

At the investigation, the fireman of the passenger train said that the gasoline tank on the motor car seemed to burst, throwing gasoline back over the locomotive and allowing it to ignite from the firebox. Many of the passengers in the motor car were burned beyond recognition, as the entire car was enveloped in flames at once.

Accidents of this sort of course are not frequent, and as stated in the report previously referred to, this is the first accident involving a motor car which has been investigated. However, this is a costly proof of the danger caused by gasoline in a collision of this sort. Makers of motor cars have guarded the gasoline tanks as well as possible, and probably but little could be done to prevent the tanks from bursting in a head-on collision. The field of operation for the motor car is quite well established. Therefore the point to be brought home is that this inherent danger be fully realized and that great care be used to safeguard the operation of motor passenger cars, especially if locomotives also run over the same lines.

Joint Car Shops

During the past year or two, suggestions have been made looking to the establishment at certain large terminals of car repair shops for the use of all roads entering such terminals. This idea has again been brought to the front and it would seem that this is a more opportune time to consider the matter, in view of the fact that the changes in the Master Car Builders' rules went into effect on October 1. Among these changes is that long desired one by which the owner must authorize either the destruction or rebuilding of a worn-out car on a foreign line. This eliminates the hauling of empty worn-out cars back to the owner and therefore does away with much lost motion. As a result, a larger percentage of bad order cars will be repaired in foreign shops.

The advocates of joint car repair shops claim with very good reason that they would cut car repair costs and at the same time provide a better supply of cars. It is obvious, too, that such a plan could only be effective at large interchange centers such as Chicago or St. Louis. A joint repair shop at an important center would do away with the necessity of the various roads maintaining individual repair plants, would do away with the necessity of each road carrying a large amount of repair parts in stock and would allow many parts of dismantled cars to be reused.

The problem presented by the joint repair shop is, however, that

of an equitable and satisfactory arrangement between the roads using such a shop. In order to insure that such a plant would work to the highest efficiency, it would be necessary that each road in the territory chosen for the experiment, should enter into the proposition. If a stock company were organized to handle the proposition, a fair basis should be taken for the share of each railway in such a company. However, most important would be the organization of such a shop and the methods of handling repairs. This shop should authorize repairs, see that they are made and see that each road is properly billed. It should have an especially well organized staff to cope with the difficulties which it would undoubtedly encounter. Mr. Schultz, chief interchange inspector at Chicago, who advocates the plan in an article published on another page believes that the present M. C. B. prices would make such a shop self-sustaining. He states that a shop could be rented to try out the proposition, before the establishment of a new plant for the purpose, and if this is possible it certainly would be the thing to do, before making a heavy investment in a new plant.

The proposition is in line with the standardization which has been gradually taking place in railway equipment and is another evidence that the roads realize that they must work in greater harmony in order to reduce costs. A factor which will have a bearing on the idea is the standard car, about which much has been said and which is being worked on at present. The time may come when the freight cars of our railways will be standard, and will be owned in common by all roads. The establishment of joint car repair shops may be a step towards this end. In any event, the joint shop is well worthy of serious thought and of trial.

Machine Tool Capacity

To bring the largest return on the amount invested, a shop must work at its full capacity. The same holds true of the machine tool. In these days machine tools are quite highly specialized; a tool is purchased for use in the shop often because it is especially adapted and is deemed necessary in order to handle certain work. Often these machines are large and involve quite an outlay. After such a machine has been in shop for awhile, it will sometimes be found that work is being done on it which is entirely different from the work for which it was intended; work which could equally as well be done by one of the older machines. If a heavy planer for use on side frames, for instance, is used with a short table movement on small castings, it is not working as efficiently as it would on the work for which it was installed, as it is consuming a large amount of power in running the platen. It is not being worked to its capacity and is doing work which could be done at a less cost on a lighter machine. True it is not always possible to keep such a machine supplied with the work on which it can work most efficiently, but great care should be exercised before such a machine is purchased to ascertain whether there will be enough work of the sort to which it is adapted to keep it going at full capacity.

Boiler Inspection Report

The third annual report of the chief inspector of locomotive boilers has recently been issued and it shows that this department has made noticeable headway during the past three years. The percentage of locomotives found defective in the fiscal year ending June 30, 1912, was 65.7, in 1913 it was 60.3 and in 1914 it was 52.9. The improvement is best shown, perhaps, by the decrease in the number of accidents, which was 856 in 1912, 820 in 1913 and 555 in 1914. It will be seen that there has been a marked decrease in 1914, a matter of about 32 per cent less than the previous year. This is the real work of the division of locomotive boiler inspection—to decrease accidents, and the figures show that it is attaining its end.

The report also shows that after having made an investigation of the specifications of locomotives there were 11,153 locomotives which had a factor of safety below four. The report states that there is imperative need of increasing this factor in order to provide protection against hidden defects.

It is noteworthy that no prosecutions for violations have been filed during the past year. Railroad officials are showing a disposition to comply with the law and recognize the fact that the boiler inspectors are co-operating with them in order to bring about better conditions. Mr. McManamy, the chief inspector always emphasizes this idea of co-operation whenever he talks before railway men and he impresses all with his fair-mindedness.

Light and Accidents

The shortest days of the year are with us and it may be well to again impress the fact that the maximum number of accidents occur at the time when we have the minimum amount of daylight. This has been shown by statistics. It is a good time to look over the shop to see that enough artificial light is provided to safeguard the workmen. A poorly lighted passageway back of a machine or an overhead obstruction in a dimly lighted corner may be the cause of a serious accident. Accidents happen all too frequently when the employee has the opportunity to see what he is doing, so at least he should not have the handicap of poor light. Painting walls white, cleaning up fixtures and dropping a light here and there makes mighty good accident insurance. One shop has the entire interior, including wood and steel work, painted white, and this with its excellent lighting system makes the illumination of the shop very striking.

Interest the Foreman

A great enthusiasm for the prevention of work accidents may be aroused by large safety meetings of workmen, but unless the immediate bosses of these men have been aroused at the same time and become possessed of a conviction that will stick, the good results of all this effort will not long continue. A foreman's "wet blanket" will speedily extinguish all the fire in any enthusiasm thus aroused and things will continue as before.

Having captured the "boss" the rest of the problem is of comparatively easy solution. It is agreed that supervision and education is the straight road to greater safety—the true solution of the injury prevention problem.

The best supervisor is the foreman because he is always on the ground and for the same reason, assuming that proper regard has been had as to his competency when selected, he is the best educator for the knowledge he imparts will be practical, of present application, and permanent value and his situation such that he may not only know that his instructions are understood but he can see that they are followed. The safety missionary; the safety committees; safety literature and prizes will be distinct and valuable aids to the foremen in inspiring the necessary co-operative spirit among all their men.—*The Frisco Man.*

Twenty Years Ago This Month

(*From the files.*)

Twelve roads entering Chicago have entered into a special agreement for the interchange of cars, the plan being to make the car owners responsible for the defects in their own cars. The executive committee chosen under the agreement consists of J. N. Barr, (chairman), W. Lavery, A. M. Waitt, William Garstang and Peter Peck.

The numerous friends of Robert Quayle will learn with pleasure of his appointment to the position of superintendent of motive of the Chicago & North Western, which position was made vacant by the resignation of William Smith, who for years has been connected with the mechanical department of that road.

The Northwest Railroad Club has elected the following officers: President, E. A. Williams, mechanical superintendent, Soo Line; 1st vice-president, Geo. D. Brooke, master mechanic, St. Paul & Duluth; 2nd vice-president, George Dixon, general foreman, Great Northern; secretary, C. A. Seeley; assistant secretary, T. A. Foque, engineer of tests, Soo Line; treasurer, J. O. Pattee, superintendent of motive power, Great Northern.

A. W. Twombly, master mechanic of the New York, New Haven & Hartford at Taunton, Mass., is making turnbuckles by taking a good quality of pipe, cutting it to the desired length and inserting in each end a wrought iron plug. The plugs and pipe are then welded and the whole is then planed crosswise, making two apertures in the pipe.

C. H. Quereau, formerly engineer of tests of the Chicago, Burlington & Quincy has been appointed assistant to D. Hawksworth, superintendent of motive power of the Burlington & Missouri Valley with headquarters at Plattsmouth, Neb.

The December meeting of the Western Railway Club was held in the lecture hall of the Field Columbian Museum, Chicago. The members went out in the morning to inspect the transportation exhibits, had lunch at the Windermere Hotel and held the regular business meeting at 2:00 p. m. A discussion of J. N. Barr's paper before the November meeting on "The Scrap Pile" was held, together with a discussion of the M. C. B. coupler. The paper of the day was then presented by William Forsyth, the subject being "Locomotive Fuel."

William Buchanan, superintendent of motive power of the New York Central & Hudson River has conducted some efficiency tests on engine 999 which is hauling the Empire State Express. The total weight of the train including engine and tender is 311.6 tons and the coal consumed per ton mile is 0.100 pounds.

The Biddle Railway Car Electric Lighting Co. has placed on the market an axle system of car lighting.

Amos R. Barrett, superintendent of motive power of the Boston & Maine has resigned on account of ill health. He is succeeded by Henry Bartlett.

Under joint car inspection at Columbus, O., B. Fitzpatrick, master mechanic of the P. C. C. & St. L., states that there has been a saving of over nineteen hours per car during the past four months. It has been decided that a car is delivered to a connecting line when it is placed on the proper track, with suitable billing.

The Panhandle has been conducting a series of tests with a view of adopting the tonnage system of rating locomotives.

In the face of the financial depression caused by the panic of 1893, labor troubles and radical legislation, nearly two thousand miles of new track was laid in the United States during the year 1894.

The American Railway Association held its fall meeting at the Blackstone hotel, Chicago, on Wednesday, November 18, at 11 a. m. Reports were presented by the following committees: executive committee; committee on transportation; committee on maintenance; joint committee on automatic train stops; committee on relations between railroads; committee on the safe transportation of explosives and other dangerous articles; committee on electrical working, and the committee on nominations.

WILLIAM E. MAGRAW.

William E. Magraw, President of The Railway List Co., Chicago, Ill., died November 24. He was taken with appendicitis Thursday morning, November 19, and was operated on the same day. Conditions seemed favorable to recovery for the first few days, but peritonitis set in and he passed away at five o'clock Tuesday.

Mr. Magraw was born at St. Peter, Minn., May 3, 1858. At an early age the family moved to St. Paul, where Mr. Magraw received his education and where he was engaged in newspaper work for many years. He came to Chicago in 1895 and after a short time spent in trade journal work he became associated with the *Railway Review* as western advertising manager. In connection with this work he later became an officer of The Railway List Co., having purchased The Monthly Official Railway List, which he enthusiastically pushed for many years. In the spring of 1909 a reorganization of The Railway List Co. was effected and Mr. Magraw, who had been its president for some time, continued as president, with the *Railway Master Mechanic* added to his responsibilities. *Railway Engineering and Maintenance of Way* was adopted by the company in the fall of 1909, and since that time Mr. Magraw had devoted all of his tremendous energy to the development of all three publications, which he found pleasure in designating (from the colors of the covers) the "Red, White and Blue."

Those associated with Mr. Magraw were, of course, aside from his family, in the best position to appreciate the sterling qualities not at once apparent to others who were fortunate in his acquaintance. His greatest fault was extreme generosity. He was actually ashamed of it and would attempt to place the credit for his various generous acts elsewhere. A person who had once befriended him in any way had a lien on all Mr. Magraw possessed, provided he needed assistance. In times of adversity Magraw's smile or gentle joke was always in evidence. He worried much because he wished to save others worry, his family most of all. Himself a high principled man, a lover of frankness, loyalty and truth, he could not condone dishonesty or

William E. Magraw.

disloyalty in others. Aside from his family, Mr. Magraw had no other interests but his business. He did not take vacations because he could not enjoy them; he spent practically all of his time at his home or at his office.

Mr. Magraw married Miss Lida Marshall on October 6, 1887. Four children were born to them, two dying in infancy. The sorrowing widow and two daughters, Elizabeth and Ruby, survive to contemplate what to them appears a desolate life robbed of the care of the kindest of husbands and fathers.

A GENERAL CAR REPAIR FUND.

By F. M. Lucore, Asst. Genl. Mgr., Sunset-Central Lines.

Optimism envelops the human race. Not all possess it, but a sufficient number do to make it a dominant quality. It must be admitted that on occasion a pessimistic air is assumed. When, however, such rare intervals arrive, the acts or ideas of others are made the subject of attack, rather than our own. Broadly speaking, we may be counted on, everywhere and always, through thick and thin, to entertain a feeling of confidence, and even affection, for ideas which we have ourselves embraced.

There is another human trait, even more pronounced than optimism. It is known by the name of laziness. This trait is rather more wide-spread than others, and rather less beneficial.

And still another trait stands out in bold relief in the human family. It is this: When individuals discuss important questions, they quickly lose themselves in a labyrinth of detail, and soon forget the main issue. They become side-tracked through clashing over questions altogether incompetent, irrelevant, and immaterial. This unskilled, lazy way of thinking tends to lead one into general bewilderment. It is apt to leave one indisposed to undertake a task which involves dry questions.

Rules—intangible things that they are—framed to cover the matter of repairing freight cars, to the average mind are so dull and uninteresting that they do not hold one's thought. The mind instinctively turns towards things which are animate—to visible objects.

Little wonder then that bare rules are improved but slowly. Nothing in them catches, much less holds, attention. In the very nature of things the few, instead of the many, must work upon these dry details which go to make up car rules, not hoping for help in their formation.

In spite, however, of everything that retards progress in evolving rules for repairing freight cars, it must be admitted that once in a while a step is taken—so important a stride that the optimism of the race justifies us in forgiving ourselves for the laziness of the race.

On October 1st, 1914, the car repair rules, at a single bound, were advanced fully twenty years. This refers to the change under which foreign cars are repaired as thoroughly as system cars. Thanks to those who have labored to skill themselves in consecutive and useful thinking, car handling has been advanced by a simple change in a single rule. Safety to property and to human life itself has been safeguarded under our very noses, and most of us are still loafing along, and don't know yet of the change.

These same minds having accomplished the advance already referred to without thought of reward, beyond that which comes to everyone through the exercise of his natural talents, are even now working away on a simple plan of financing car repairs. Their ideas are not altogether harmonized as to detail; in the main, however, they stand out distinct and clear. The essential points they wish to establish are that the creation of a car repair fund for and by the railroads as a whole will accomplish:

(1) A large money saving to American railroads, and

(2) Far greater equity to car owners.

Car repair charges may then be made against the general car performance of the whole country, rather than against each particular car making the performance. Everyone agrees that each road knows the sum total of money it spends in any particular period in repairing freight cars—system and foreign. Everyone will agree also that the ratio of each road's car repair expense to the total of the country is ascertainable with equal ease. Some roads do more than their share of car repairing, and many do less. Everyone agrees that each railroad knows how many miles, all told, freight cars move on its rails. The ratio which this mileage bears to the total of the entire country is also easily ascertained. The percentage of each road's car mileage to the total car mileage represents the percentage of the total car repair expense which each road by rights should bear, so the advocates of a car repair fund maintain. In other words, they promote the law of averages, and pro-rate the expense of car repairs about as it would be prorated if all of the roads of this country represented a single system. They commend to the roads as a whole the practice which even now obtains on existing trunk lines, whereby branches or divisions are charged with their proportion of expense, based on business handled.

It is the thought that based on the above figures, each road, at the commencement of a season, should contribute to a general car repair fund, and then month by month remit to or draw on this fund in keeping with their proportion of the total mileage performance. Obviously the road doing more than its pro-rata share of car repairing would from month to month reimburse itself by drawing on the car repair fund; likewise a road doing less than its pro-rata share of repairing would month by month remit to the car repair fund, to whatever extent it failed to perform its pro-rata share of repairing.

All the proposed figures being easily verified, would overcome much of the objection to the present system of settling between railroads covering car repair expenses. It is readily agreed that too much opportunity is now afforded for inaccurate accounting.

The need of changed accounting methods to meet changed conditions has been obvious for years. The change of October 1st, 1914, whereby foreign cars can no longer be sent home for the purpose of repairs accentuates this need by increasing the amount of repairs which will hereafter be done to foreign cars.

Those who will engage themselves in the task of thinking along purely plodding lines are urged to join in the campaign now launched to perfect this phase of the service.

For the encouragement of those who realize the crying need of constructive work, yet who hesitate to subject themselves to the ridicule of those holding different views, let it be constantly remembered that every advance in the rules under discussion which has been made since cars first came to pass from one railroad to another, has been combatted; the more important the change, the greater the opposition.

Think what can be accomplished by a body of qualified men meeting at stated intervals, working out methods of spending, in a business-like way, a fund for the upkeep of the cars of this country.

Is it not obvious that heavy repair work can be arranged for periods in which business is light—that car repair parts will be standardized and that one dollar can eventually be made to do well what is now being done rather poorly?

CHICAGO MEETINGS, A. S. M. E.

The Chicago section of the American Society of Mechanical Engineers has announced that its meeting to be held on January 8, 1915, will be a railroad night and the subjects will be "Locomotive Superheaters" and "Locomotive Stokers." The subject for the meeting of February 26 will be "Ice Making as a By-product of Central Stations," and on April 2 the subject will be "Power Plant Apparatus and General Equipment." All meetings will be held in the red room of the Hotel LaSalle, Chicago, beginning with a dinner at 6:30 p. m., to be followed by speaking at 8:00 p. m. All interested are invited to attend, whether they are members or not.

SAFETY-FIRST work on the Chicago & North Western, where it was first inaugurated by R. C. Richards, has made remarkable progress. In the fifty-three months ending June 30, 1914, there were 369 fewer deaths and 11,258 fewer accidents among employes than in the corresponding preceding period.

Pacific Type Locomotives, C. & O. Ry.

The Chesapeake & Ohio has recently received and placed in service six Pacific type locomotives which are believed to exceed in tractive power any Pacific type locomotive previously built.

The part of the line between Charlottesville, Va., and Hinton, W. Va., a distance of 175 miles, crosses three mountain summits, viz.—the Blue Ridge, North Mountain and the Alleghanies and forms a difficult problem to economically handle the through passenger traffic. The mountain resorts, among which are the Virginia Hot Springs and the White Sulphur Springs of West Virginia, demand the very best of service and equipment. Trains of ten all steel cars, weighing 674 tons are a regular daily problem and this has required the regular use of expensive double headers.

Based on the experience with other locomotives on this part of the line, it was decided that a locomotive could be built with sufficient power to handle these trains without double heading.

Everything considered, the Pacific type appeared to be the best suited and designs were gotten out for the engines, as described in this article.

fitted with a manhole for permitting interior inspection without disturbing the throttle valve.

The frames are 6" wide and braced by box castings. The piston extension is the American self-centering type. A simple and substantial Walschaert valve gear with the valve stem guide integral with the steam chest cover is used with 16" piston valves.

The tender tank of the water bottom type is equipped with the Street stoker conveyor and has a capacity of 9,500 gallons of water and 14 tons of coal. It is carried on a substantial frame of rolled steel and plate construction. The tender trucks are built with side frames of the Andrews type, with elliptic springs and heavy cast steel bolsters. 36" forged steel wheels are used with 6"x11" M. C. B. axles.

The requirements that must be met in order to make the schedule time on the Clifton Forge division are extremely difficult. West bound from Mechums River to the summit of the Blue Ridge is a continuous uncompensated grade of 75 feet to the mile with curves of 10° and covers a distance of 14 miles. One train of ten steel

Pacific Locomotive for Passenger Service, C. & O. Ry.

cars, weighing 674 tons, is scheduled at 22½ miles per hour on this grade, while another train of eight steel cars, weighing 551 tons, is scheduled at 29 miles per hour. From Staunton to the summit of North Mountain, a distance of 13 miles, the conditions are still more difficult. The first six and one-half miles contains four and one-half miles of up grade, varying from 75 to 80 feet to the mile and the last six and one-half miles is a continuous grade of 80 feet to the mile. The scheduled speed for the first mentioned train is 25½ miles per hour and for the second, 35 miles per hour for this 13 miles. The schedule over the remainder of the division permits but little time to be made up. While some of the most powerful passenger locomotives in existence are in use on this division, these new locomotives are handling these trains more satisfactorily than any of the older designs.

No innovations were attempted, but the different factors were worked out to give as good proportions as possible and fuel saving and power producing features were used to build as powerful a machine as possible within the dimensions. The engines are considered to be beyond the capacity of a fireman and are equipped with type "C" Street stokers.

The large boiler and wide firebox and the application of the stoker made the arrangement of the cab a difficult matter and this was facilitated considerably by the use of non-lifting inspirators, Raggonet reverse gear and placing the steam turret outside of and in front of the cab. Clearance restrictions made it necessary to place the bell off the center of the boiler and the headlight dynamo in front of the smoke box.

The boiler is believed to be larger than any previously applied to the Pacific type, the firebox being exceptionally wide and deep. It is of the extended wagon top type with a radial stayed firebox. The barrel is 83-11/16" outside diameter at the front course and 90" outside diameter at the largest course. No combustion chamber was used as clearance limitations forbade the increase in diameter a conical type boiler would have required with the first course of the diameter used. The fire box has an average depth of 84" and is 120⅛" long by 96¼" wide, with water spaces of 4½" on the back and sides and 5" at the front. The crown and sides of the firebox and the roof and sides of the shell are made from single continuous pieces. The crown sheet is supported by a row of sling stays attached to a heavy "T" bar in front and by screwed and riveted radial stays, except the six center rows which are screw stays with hexagon heads. One inch screwed staybolts are used with Tate flexible staybolts in the breaking zones.

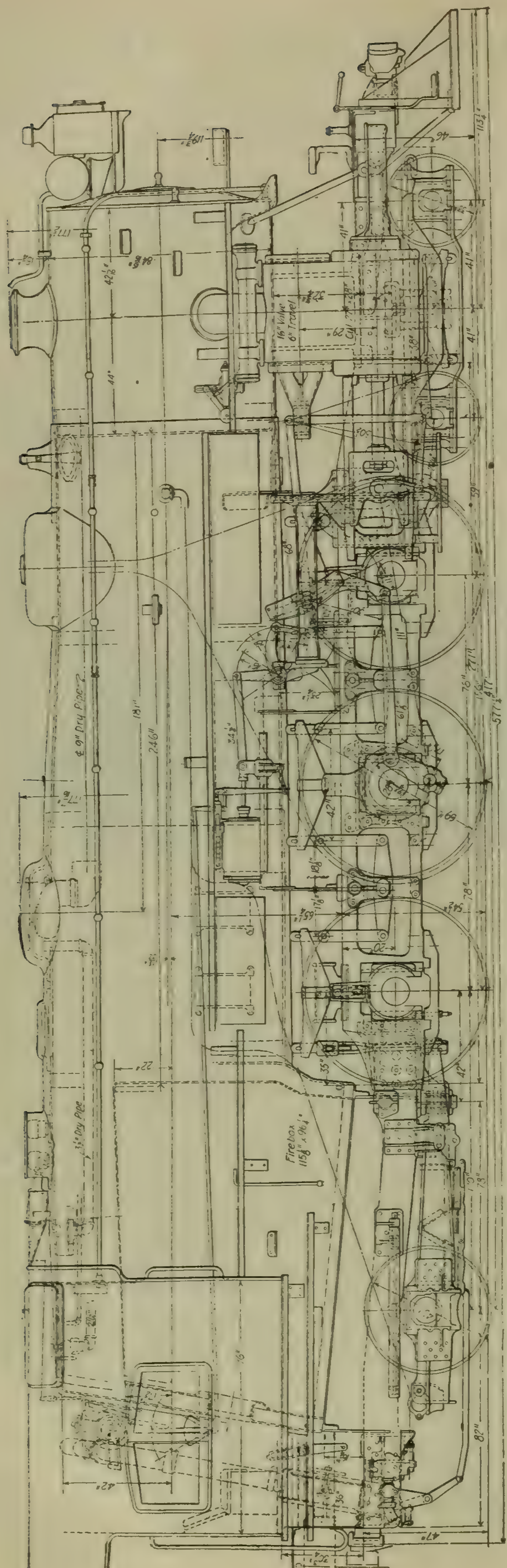
The boiler contains 244-2¼" tubes and 43-5½" flues and is

They were built at the Richmond works of the American Locomotive Company to specifications prepared by the railway company, and while they have been in service but a short time, they have demonstrated their ability to do the work for which they were designed.

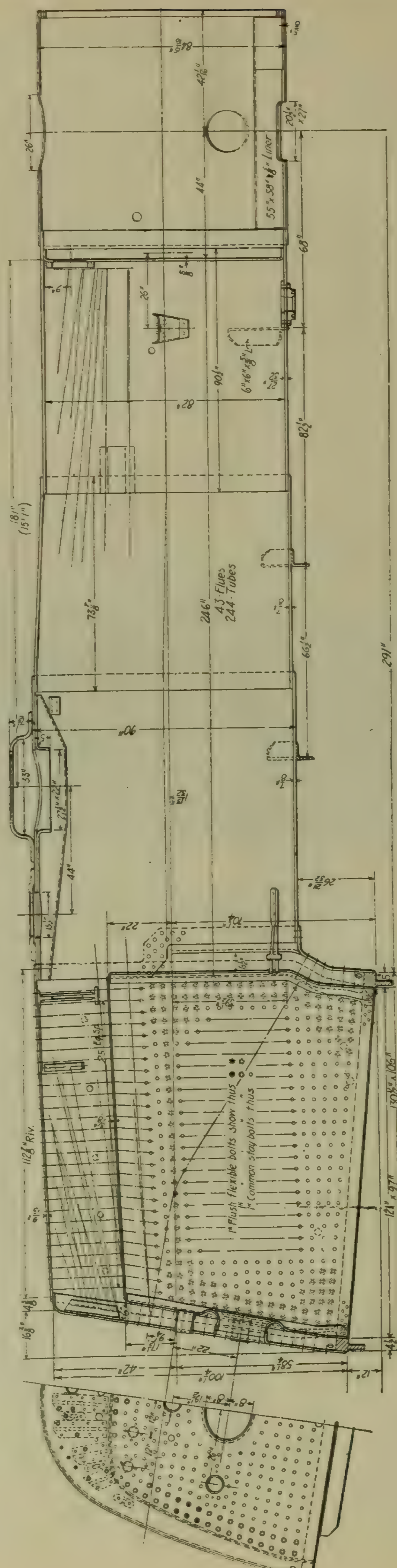
The special equipment includes the Schmidt superheater, Cole outside journal trailing truck, radial buffing device, American arch, Franklin pneumatic grate shaker, Cole long main driving box, Trojan packings, Vanadium steel frames and rods, Mellin by-pass valve, Hancock 5,500 gallon capacity non-lifting inspirators, Watters sanders, Nathan lubricators, Westinghouse-American driver brakes and Westinghouse-Farlow draft gear.

The principal dimensions and ratios are as follows:

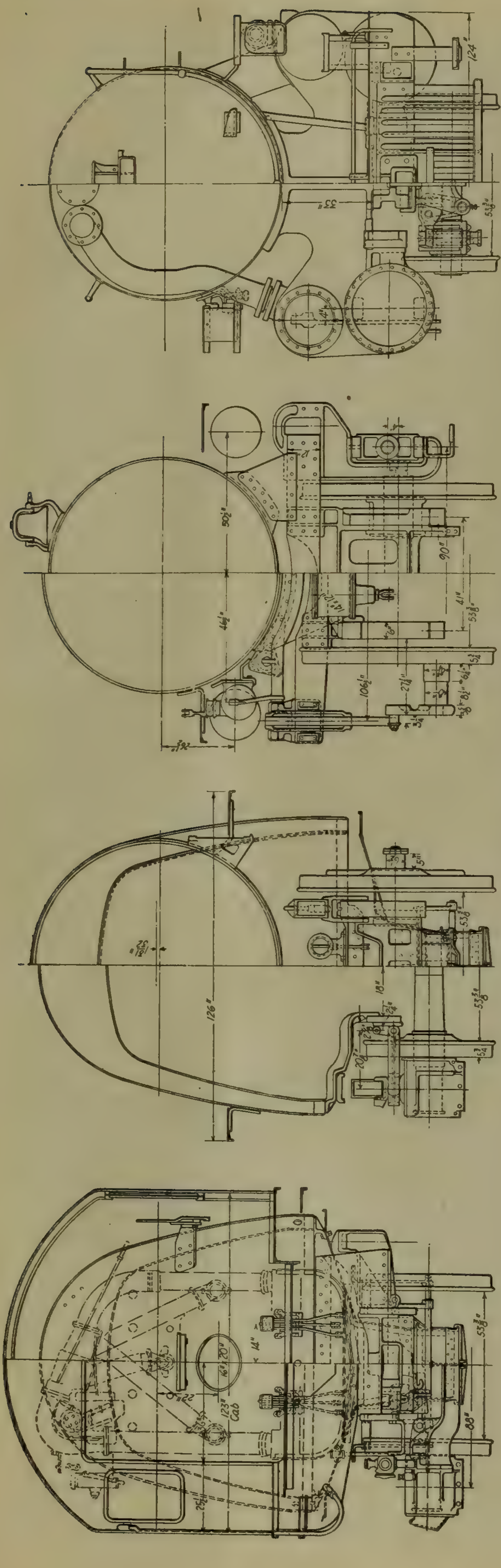
Gage, 4' 8½"
Fuel, Bituminous coal
Tractive effort, 46,500 pounds
Weight in working order......312,605 pounds
Weight on drivers......191,455 pounds



Elevation of Pacific Type Locomotive, Chesapeake & Ohio Ry.



Boiler for Pacific Type Locomotive, Chesapeake & Ohio Ry.



Sections of Pacific Type Locomotive, Chesapeake & Ohio Ry.

Weight on leading truck	56,675 pounds
Weight on trailing truck	64,475 pounds
Weight of engine and tender in working order	497,105 pounds
Wheel base, driving	13 ft. 0 in.
Wheel base, total	34 ft. 9 in.
Wheel base, engine and tender	71 ft. 11½ in.
Length over all	82 ft. 6½ in.
Ratios.	
Weight on drivers + tractive effort	4.12
Total weight + tractive effort	6.72
Tractive effort × diam. drivers + equivalent heating surface	538.00
Evaporative heating surface + grate area	55.80
Equivalent heating surface + grate area	74.30
Firebox heating surface + equivalent heating surface	4.74
Weight on drivers + equivalent heating surface	32.25
Total weight + equivalent heating surface	52.30
Volume of both cylinders, cu. ft	18.55
Eqiuvalent heating surface + volume of cylinders	322.00
Grate area + volume of cylinders	4.33
Cylinders.	
Kind	Simple
Diameter and stroke	27 in. × 28 in.
Valves.	
Kind	Piston
Diameter	16 in.
Greatest travel	6 in.
Outside lap	1 in.
Inside clearance	⅛ in.
Lead	3/16 in.
Wheels.	
Driving, diameter over tires	69 in.
Driving, thickness of tire	3½ in.
Driving, journals, main, diameter and length	11½ × 23 in.
Driving, journals, others, diameter and length	10½ × 14 in.
Engine truck wheels, diameter	33 in.
Engine truck journals, diameter and length	7 × 12 in.
Trailing truck wheels, diameter	45 in.
Trailing truck journals, diameter and length	9½ × 16 in.
Boiler.	
Style	Wagon top
Working pressure	185 pounds
Outside diameter of first ring	83 11/16 in.
Firebox, length and width	120⅛x96¼ in.
Firebox plates, thickness	⅜ and ½ in.
Firebox water space	4½" back and sides, 5" front
Tubes, number and outside diameter	244—2¼ in.
Tubes, material and thickness	Seamless steel, .125 in.
Flues, number and diameter	43—5½ in.
Flues, material and thickness	Seamless steel, .150 in.
Tubes and flues, length	20 ft. 6 in.
Heating surface, flues	1263 sq. ft.
Heating surface, tubes	2933 sq. ft.
Heating surface, firebox	255.4 sq. ft.
Heating surface, arch tubes	27.4 sq. ft.
Heating surface, total	4478.8 sq. ft.
Superheater heating surface	991.0 sq. ft.
Grate area	80.33 sq. ft.
Smoke stack, diameter	20 in.
Smoke stack, height above rail	14 ft. 9½ in.
Tender.	
Frame	13 in. steel channels
Wheels, diameter and material	36" forged steel
Journals, diameter and length	6x11 in.
Water capacity	9500 gallons
Coal capacity	14 tons

Equivalent heating surface = 4478.8 + (991x1.5) = 5965.3.

DUPLICATING BACK FLUE SHEETS.

By W. E. O'Connor.

One of the troublesome repair jobs, which is often met with by the layer out in the railway repair shops, is the renewing of back flue sheets. The troublesome part may well be attributed to the fact that the contour of the flanged portion of the sheet bears no definite relation to the center line or axis with respect to symmetry.

Prior to the introduction of hydraulic pressing machines, for flanging boiler plates, the practice for renewing back flue sheets was slow and cumbersome. Many methods have since been brought forth by the leading repair men as to which is the most expedient and reliable way for handling repairs of this sort.

At the shops where the writer is employed patterns covering the disposition of flue-holes, staybolt, brace and foundation ring rivet holes have been established to suit the several classes, so that when engines pass through the shops for classified repairs, including a new back flue sheet, the new sheet is gotten out, in so far as the punching of the pilot holes for flue bolts, staybolt, brace and foundation ring rivet holes is concerned, as shown in half-

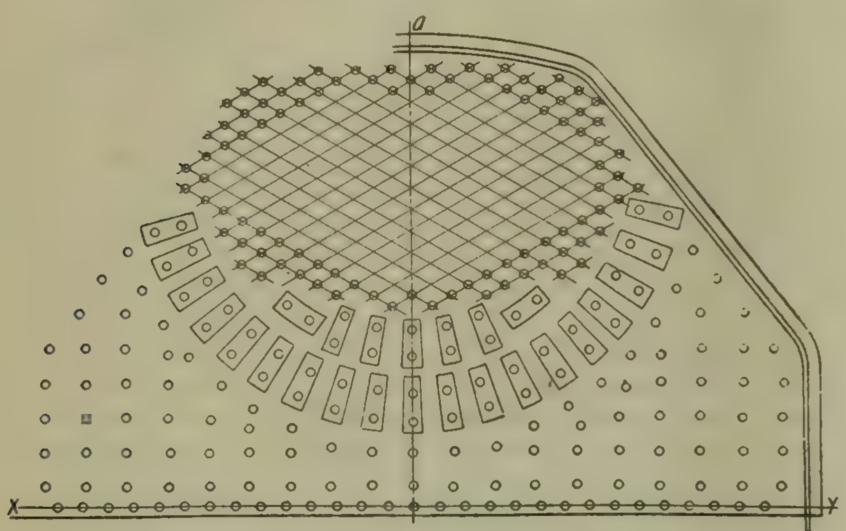


Fig. 1 Fig. 2

Duplicating Back Flue Sheets.

view, Fig. 1. In the meantime, the old sheet being removed, special templates of light bar iron, one-fourth inch by one inch in section, are shaped to either side of the old sheet from points at the top center to the rivet line at the foundation ring. Next the templates are placed on the new sheet, as shown in the half-view, Fig. 2, so that point *a*, the vertical height, and points *x y*, the horizontal width at the rivet line, are cut by similar points on the templates taken from the old sheet. Now the brake and trimming lines for the flange are drawn in.

The flange turner checks up the shaping of the flange with the templates, cutting similar points as explained in the layout after annealing the sheet, etc. Also points for the disposition of the rivet holes on the rim of the flange are lifted from the old sheet on the templates and transferred to the respective sides, on the rim of the new sheet, completing the layout.—*The Boiler Maker.*

THE RAILWAY DEVELOPMENT ASSOCIATION, composed of development and immigration officials, met in Chicago on November 9. One of the speakers advocated an auxiliary six-foot standard road bed along with the present standard of 4 feet 8½ inches, to be obtained by laying an extra rail. The idea was that this would permit of much larger box cars being used and thus effect economies in operation. Nothing was mentioned, however, about a few little things in connection with the plan, such as bridges, tunnels, yards, etc.

The Oregon-Washington Railroad & Navigation Company has started on its terminal buildings at Spokane, Wash. It will consist of an 11-stall roundhouse, a machine shop, 80 feet by 120 feet, a power house, 40 feet by 50 feet, a coiling plant, cinder pit and coach cleaning facilities.

THE RAILROAD SITUATION.*

By Samuel Rea, President, Pennsylvania R. R.

Although holding no commission to speak for the railroads as a whole, the seriousness of their present position may warrant an an expression of my views on the general railroad situation. It is no difficult task to sum up the present railroad situation. We can all see that something is wrong, but no useful purpose will be served unless we can suggest some constructive methods of improving railroad conditions.

Examine, for instance, the Eastern railroads, which reach the centers of the largest population and heaviest traffic of the country, and you will find greatly diminished gross revenues and a still greater proportionate reduction in net revenues; their purchasing powers are stringently curtailed, and their credit has been greatly weakened. This condition arises from causes largely beyond their own control, so that the return earned during the past year upon the money invested in the road and equipment of these railroads amounted to less than 4 per cent. This serious condition is not new, but it is now acute. We have been living on hope at least since 1910, when the downward trend was clearly indicated; how much longer we can exist on that precarious asset, I will not venture to say, except to suggest that it takes more than hope, advice, or enthusiasm, or all combined, to pay wages and taxes, provide satisfactory service, pay dividends, and retain a proper credit basis to obtain capital for improvements and extensions.

Increased traffic will not cure the railroad malady, for remember that up to the present all their economies and efficiency, obtained by increased train loads, etc., have been offset by increased costs, wages and taxes. These companies therefore need not merely the very moderate increase in rates for which they petitioned the Interstate Commerce Commission, but also all the revenue that can be secured by working out in practice the various other means suggested by the commission for increasing revenue.

A full consideration of the railroad position and the effects of public regulation must not, however, stop there. Irrespective of any decision in the rate case now pending, whether it be finally favorable (as we trust it will be) or unfavorable, it is evident that the time is ripe for suggestions concerning constructive railroad legislation and policy.

I need not remind you that after agriculture—and what would agriculture be without railroads?—the railroads are not merely the most important industry in the country, but they are also in their essence public institutions performing functions which are by their very nature of a public character. They are owned in part by an army of individuals, actually holding their stocks and bonds, and in part by institutions such as savings banks, insurance companies, universities, hospitals and other philanthropic enterprises, in the welfare of which many more millions of individuals are vitally concerned. These are largely dependent upon income derived from the money they have invested in the service of the public, and rightfully they hold railroad managers responsible for this income. It should be the business of government regulation, not merely to see that the public is properly served by these railroad managers, but also to see that the owners of the properties are fairly compensated, and that their revenues are sufficient to properly discharge their duties to the public. Otherwise the managements of these companies will be prevented from efficiently discharging their obligations to the public and their owners. The railroads must give the public good service and their operations must be continuous in good times and in bad. Moreover, the railroads of the country pay over $140,000,000 in taxes every year, a sum equal to 5 per cent on nearly three billions of dollars, requiring over 16 per cent of their net operating revenues. They pay good wages to their own employees and furnish profitable employment for the industries which furnish railroad materials and supplies.

But apparently the interests of everyone have been safeguarded

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* An address at the Chamber of Commerce meeting, New York City, on December 3, 1914.

under public regulation except the interests of those who furnish the money for the public service; and we must protect these investors upon whom we must rely for future capital. Failure in the last decade to protect the railroads and railroad investors has at last produced a lack of confidence in public regulation, and we now know that through the weakness of the railroads the whole country is suffering. Upon this great industry, through the operation of too many hastily enacted federal and state laws, and by failure to provide and adjust the machinery necessary to enforce these laws by reasonable and practical methods, a mistaken policy of repression has been imposed, which has not permitted railroad charges to increase with the enforced increase in the cost of their operations. This has caused loss to existing railroads, and has precluded the building of new lines, and the making of needed improvements and betterments on the present roads. The inherent weakness of the present situation is that we as a people seem to have assumed that the present railroads and their equipment and facilities are complete, and are sufficient for present and future needs, and that the chief function of public regulation is to curtail their revenues, increase their expenses and lessen the margin of return. In this growing country, the present railroads are far from adequate, and therefore the policy of repression is bound to bring, if it has not brought already, a day of reckoning. Let us not forget that if we expect people to continue supplying their savings for our railroads, present and future, their earnings must continue to be what these investors regard as reasonable and sufficient, and they are not likely to be governed by the opinions of legislators, or commissions in this respect. The present policy of repression must be modified and lack of confidence must be removed, or these millions of investors will seek other avenues to utilize their capital.

There are some particular features of the railroad situation, incidental to public regulation, to which I would direct attention.

The railroads are existing under conditions that breed business depressions, because of arbitrary, heavy and frequently unjustifiable burdens imposed upon them, by legislatures, state and and national, and there are still many wasteful legislative experiments forthcoming unless the authors discover that the public will not willingly pay their cost. Public opinion is now convinced, I feel, that the railroads are entitled to more equitable treatment under public regulation, and that opinion has opened the way for me to offer some suggestions.

The present situation is not the result of premeditated action or of a clearly defined punitive public policy; it is the result of our failure to fairly adjust our national conception of the rights and duties of these common carriers, and to adopt our new laws for public regulation to rapidly changing commercial and financial conditions. It is not, therefore, a case for mere sterile criticism, but for mutual study and co-operation to the end that the evils now existing may be clearly recognized and corrected. The public, the railroads and the commissions, state and federal, should unite in an effort to ascertain and finally establish the principles upon which wise regulation should hereafter proceed, so as to retain for the people at large the advantage of our American system of private ownership and operation under public regulation, and avoid being forced into another system far less desirable in a country such as this.

Can it reasonably be contended that any large and important business enterprise, whether individual or corporate, could be successfully conducted if, notwithstanding radically changed conditions and substantially increased costs of production, it could only increase prices subject to the power of an administrative body which on its own initiative and without a hearing might suspend the increased prices for an extended period? Under the existing federal law, increases in railroad rates, no matter how reasonable or justifiable, may be suspended without any hearing, for at least four months after they would have become operative. In practice, this means five months after the rate schedules are filed with the commission, and the suspension may be extended by the commission for a further period of six months. It is, therefore, possible even if the new rates are justifiable, for the railroads to lose nearly a year of benefit from them while the commission is determining their reasonableness. Is the public welfare promoted thereby? From practical experience and in a spirit of fairness and justice, I should say it is not, and the period of such suspension, and the determination of the question at issue, ought to be restricted to sixty days after the date of filing new rate schedules with the commission.

Another trouble in the present situation is that the Interstate Commerce Commission has been overburdened with work and with responsibilities, many of which must be deputed to a large corps of subordinates, so that in many instances direct consideration by the entire commission is impossible. The work of the Interstate Commerce Commission, as originally designed in 1887, was to prevent unjust discrimination in rates or service, to see that rates were reasonable, to secure publicity of railroad rates and practices, prescribe uniform railroad reports, and primarily act as a referee between the public and the railroads. The commission was given limited but well defined powers within reasonable scope. Now, however, as the result of new laws, the scope of its control of railroad operations and development has been largely extended. It could materially assist railroad development, but so far it has proven impossible for seven men in one center to act not merely as regulators but as administrators of the railroads, leaving the financial results and responsibility of that administration to be borne by the companies and their owners.

There is also a certain amount of disagreement between the federal and state laws and orders of commissions, and of failure to recognize the inroads on railroad revenues of new laws, orders and of governmental awards.

Let me use just one example of the commercial chaos resulting from such conflict. The recent difference in the views of the Interstate Commerce Commission, on the one hand, and the Public Service Commission of New York, on the other, in connection with the allowances to industrial railroads, has, during the last eight months, resulted in freight rates, via the lines of the New York Central (whose route is intrastate) from one of the large industries at Buffalo to New York City, and to other places on its line, lower than via any of the other trunk lines, as their routes between Buffalo and New York are intrastate, and there is nothing that the other railroads could do to meet this situation, injurious as it was, not only to themselves, but also to industries local to their lines. The same situation, arising from the same cause, existed in the state of Pennsylvania, as between the Pennsylvania Railroad Company and other trunk lines. These differences must be reconciled for the welfare of the public and the railroads.

In the practice of public regulation, from the constructive side, I would at this time suggest:

First—That the Interstate Commerce Commission should be materially increased, and so organized as to be able to deal promptly with the very important railroad questions affecting all parts of this large country, and thus conserve the time and energy of railroad officers, the public and the commission. The additional members of the commission should be selected from men having experience in railroad management, operation, traffic and finance, and if men of broad business experience were also added it would be very helpful.

Second—That the position should be placed beyond political influence, by a long tenure of office, and with compensation sufficient to attract and retain men of the widest experience and greatest ability. We recognize the necessity for men of this character and technical experience in dealing with banking and other broad business enterprises, and we must recognize that equally wide experience is just as essential to deal intelligently and wisely with the railroad problems.

Third—That the regulatory power of the Interstate Commerce Commission should be clearly extended to the supervision and control of all rates and practices which directly or remotely affect interstate transportation or commerce.

Fourth—That the Interstate Commerce Commission should be given the power to interfere, by appropriate action, whenever necessary to maintain a rate structure approved by, or satisfactory

to, it, even though, to accomplish this, it should be necessary for the commission to prevent reduction of rates which would have a contrary effect, or to compel advances of rates found by the commission to be unreasonably low. An unreasonably low rate may be beneficial to some one or more shippers, but the rates of some other shippers are sure to be disadvantageously affected thereby.

Fifth—That for the existing repressive policy of public legislation, a constructive policy should be substituted, and existing legislation should be so modified as to permit the railroad companies to do their full share in the development of the country's resources. It will naturally follow that the commission should be enabled, and indeed required, in the determination of questions involving railroad rates and practices, to deal with the questions before it, not merely from the standpoint of the shipper and the carrier, but from the larger standpoint of the entire country, and on such economic and business lines that due and controlling weight may be given to these larger interests essential to the public welfare. Such a change in public policy and legislation is requisite to encourage the investment of private capital for railroad extensions and additional facilities.

For instance, I seriously question the practical utility of railroad valuation, for I believe that very few railroads are overcapitalized, and I know the public is not required to pay higher rates on weak roads than on the more conservatively capitalized railroad lines. Therefore, while the railroads are cordially and fully co-operating in the work of federal valuation, yet under present conditions and when economies are being enforced everywhere, I look to the commission, under such an equitable public policy as I have in mind, not to commit the country and the railroads to so vast an expenditure until one system, or the lines in one section of the country, shall first be valued and the results demonstrated to the country.

Sixth—That, as another necessary result of a constructive and equitable policy towards railroads, and with a commission amply strengthened to deal with railroad questions, Congress would no doubt refer to the commission for investigation and report such legislation as affected wages, employees' working hours and conditions, increased taxes, boiler inspections, extra and unnecessary men on trains, non-compensatory mail and parcel post service, railroad valuation, improved stations, grade crossing elimination, and other matters which seriously affect railway revenues and expenses. Due weight to these heavy expenditures would thus be given in approving rate schedules, and a tangible basis would be thereby provided on which to continue the regulation of these matters (if essential to the public welfare) without injustice to the railroads. The inability of the railroads to protect themselves in respect to increased wages fixed by governmental action could not be more forcibly presented than in the November, 1913, report of the Board of Arbitrators under the Newlands act, relating to conductors' and trainmen's wages on which your president served as chairman.

Seventh—That the extraordinary power to suspend rates without a hearing should be limited to a period not exceeding sixty days after being filed with the commission, or some such reasonable period. If after such hearing as could readily be had within this period, coupled with the information and data already possessed by the commission, from the current and special reports made by the railroads, under its uniform accounting regulations, the commission could not be satisfied that the increase proposed ought not to be made, the rate should rightfully become effective, and the present confusion and delay would end. The railroads as an act of self-preservation will always endeavor to make their service and facilities satisfactory, and rates reasonable, because only in this way can they make friends, encourage business and earn profits.

In conclusion I say that considerable emphasis has been laid upon the fact that the railroad companies, and their owners, are deprived of an appeal to the courts for the protection of what they conceive to be their just rights as against the orders of the commission. I am willing, however, to continue relying upon public regulation and public opinion to protect the railroads, although I cannot overlook the fact that the Eastern railroads are earning a return of less than 4 per cent on their property investment. If this is not approaching confiscation, how much less must we earn before reaching that point? Surely the country does not want impoverished railroads unduly restricted in the conduct of their business. What it does want is strong, aggressive lines, built and improved with private capital, efficiently managed and operated, subject to equitable public regulation.

What I have suggested may not meet all the difficulties in the public regulation of railroads. Other helpful suggestions will doubtless be forthcoming from railroad and business men and commercial bodies, etc., and, I trust, from some statesmen. There can be no difference of opinion that public regulation must be equitable so far as the railroads are concerned, and must be adjusted to promptly respond to business conditions. Such a change will encourage initiative and enterprise in railroad management and will assure investors, here and abroad, that their money has the full protection of our laws and that they will be equitably dealt with.

I believe in regulation by commission, and I urge, therefore, that we do not encourage destruction of such regulation, but rather its conservation, by adapting it, as we have banking regulation and other laws, to suit the needs of the country as they change from time to time. We must look beyond the present obstacles and view the whole subject from the statesman's standpoint. Under an enlightened policy of public regulation, but not repression, the railroads will be placed and kept in a strong position to meet increased traffic demands, as well as to live healthfully in times of depression. If we now by equitable dealing insure their strength, one of the greatest obstacles to the recovery of financial confidence and business enterprise can be removed.

AMBULANCE TRAINS IN ENGLAND.

The Midland Railway of England has recently supplied two military ambulance trains for the War Office, consisting of ten coaches each. These coaches were taken from traffic, converted and fitted up in the shops of the road at Derby. The accommodations of each train consist of five hospital wards, sleeping accommodations for medical officers, nurses and staff, and special compartments.

Interior of Ward Car.

The illustration shows a view of one of the ward cars with the beds in place, but not made up. These beds can be folded up against the walls when not in use. It will be noted that they are arranged in upper and lower berths, there being 20 in each car. All the cars have clere-story roofs and are vestibuled. In order to maintain cleanliness, the interiors of the coaches are painted with white enamel and the floors are covered with linoleum.

Port Huron, Mich, has raised a bonus of $100,000 to insure the rebuilding in that city of the shops of the Grand Trunk.

THE MODERN TUBE FOR LOCOMOTIVE SERVICE.*

By P. J. Conrath, Tube Expert, National Tube Co., Pittsburgh, Pa.

The modern boiler tube, as manufactured today, is made of a special grade of open-hearth steel by either the lapweld or seamless process. The material selected for this purpose is kept up to the highest standard in chemical and physical properties in order to produce a strong and ductile tube which will successfully withstand the rigid requirements of service. The methods of manufacture are improved, the tests severe, and the inspection most careful, so that the finished tube will be adapted to meet not only all the demands of locomotive service, but also expanding, flanging and beading, and the exigencies of repair requirements from time to time.

Let us consider the development of the locomotive tube. In the building of the first locomotive, copper tubes were probably used, but the necessity for a less expensive material soon led to the use of welded charcoal iron. This tube was first made by the buttweld process of drawing the heated plates or skelp, as it is known to the trade, through a bell-shaped ring which forced or butted the edges together.

Buttweld charcoal iron tubes were used for some time, but later, when the lapweld process of manufacture was invented, this improvement was applied to tubes for boiler service. The lapweld tube was, of course, better adapted to stand the manipulation required in turning over and beading and the increased steam pressure, and therefore gave improved service.

Charcoal iron, however, from the nature of its manufacture, is produced in comparatively small quantities, because the manual labor involved does not permit the handling of heats or lots larger than 500 pounds, and as a consequence does not produce the uniform product now required for locomotive service. Charcoal iron is only about half as strong as steel in the direction at right angles to the center line of the tube, and this is unfortunately just where strength is required.

When the Bessemer process of purifying pig iron was applied to the tube industry in 1886, the resultant metal was a mild, well-refined iron, purer than charcoal or wrought iron, but was classed as steel, because it was refined in the Bessemer converter. This steel is equally strong in all directions and marked a considerable improvement over charcoal iron.

Then in 1887 the seamless process for making tubes was introduced, and ten years later its value was shown by the fact that railroads were becoming rapidly interested in the development of its possibilities. Seamless tubes were made of soft basic open-hearth steel, Bessemer being unsuited to the process. Subsequent tests also proved open-hearth steel to be better adapted for lap-welded tubes, as it was found to be much less liable to become brittle while in service.

The improvements in the method of manufacture of this steel gave such gratifying results as to finally lead the largest manufacturers of tubular goods to abandon altogether the production of charcoal iron boiler tubes, devoting their attention to the manufacture of the special grade of steel which experience has proved to be the best material for the purpose.

The market now affords practically three classes of tubes for locomotive service; lapweld charcoal iron, seamless (cold-drawn and hot-rolled), and lapweld steel tubes. When the action of corrosion on the two metals, iron and steel, is compared, and the durability and economy in service is investigated, the conclusion that steel is equal to charcoal iron in this respect for tubes will be found to be fully confirmed.

Those interested in looking into this matter should examine the reports on the steel boiler tubes which have been submitted for several years past to the annual conventions of the Master Boiler-makers' Association. These reports all represent unbiased service tests and are authentic and reliable.

Besides the greater strength, ductility and uniformity obtained in making tubes of basic open-hearth steel, a special process of treating the metal, which better enables it to withstand corrosive action, has been successfully developed. This special process, known as Spellerizing, produces in the tube an exceptionally dense and uniform surface, which has been proved in service particularly efficacious in resisting the effects of corrosion, especially in the form of pitting. In the manufacture of "Spellerized" lapweld tubes, the bottom surfaces of the steel blooms are alternately knobbled and smoothed down by passing the hot bloom first through a series of rolls which have a regular series of knobs cut on their working surfaces, and then through plain rolls which in turn smooth down the roughened or knobbled surface, the operation being repeated several times. This produces alternately a roll-knobbling or kneading and a smoothing down of the surfaces of the plate, rendering the texture more dense and uniform, strengthening the resistance of the tube against corrosion.

It has also been found of advantage to devise a special test for "Spellerized" lapweld tubes intended for locomotive service. This test is made on each of the two crop ends cut from every boiler tube, and consists of a horizontal flattening, vertical crushing and flanging test, made on the cold tube in one operation, while held in a specially designed hydraulic machine. This test insures that the weld is as strong as other parts of the tube, and that the physical properties are uniformly up to the standard requirements. This is an eliminating test, and is given in addition to the hydrostatic inspection and other tests to which these boiler tubes are subjected in the course of manufacture. It is an eliminating test because any tube is scrapped if, under the rigid conditions of the test, a trace of weakness or any other defect is developed.

The manufacturer has been hampered ever since the first tube was made by a variety of specifications. It has been our object to make the best tube possible for locomotive service. The American Railway Master Mechanics' Association specifications of 1913 were adopted as the result of their committee's labors to reconcile the different specifications, and was a great step in advance. The manufacturer can make a better tube under this specification than under any of the older ones, and with more assurance of uniformity in quality as soon as this standard becomes universal.

It is rapidly becoming a well-known fact that soft basic open-hearth steel tubes, either seamless or lapwelded, withstand the severe treatment encountered in the process of expanding into the flue sheet better than charcoal iron. The steel, being more rigid than the iron, requires less attention while in service. The life of the tube today is governed by the number of times it can be worked without destroying the life of the material. The steel, being more dense and rigid, will stand more working and reduction without any ill effects to the tube, either in splitting or breaking off of beads, etc. Owing to its density, the steel has greater holding power than the iron, thus considerably reducing maintenance cost, and giving increased mileage between settings of tubes, as well as reducing engine failures due to leaky tubes to a minimum. The steel beads are stronger than the charcoal iron, and are thus better able to resist the stresses incident to modern service, and eliminate the bulging of tube sheets.

The practice in a large number of shops is to use steel almost exclusively for safe ending rather than to use iron and steel alternately. There seems to be no difficulty in welding steel safe ends on steel tubes under these conditions. In safe-ending, it is best to bring the body tube to a bright orange heat (1750° F.) for expanding to admit safe end, and allow it to cool to at least a blue heat before reheating for welding. Precautions should be taken not to overheat the metal near the weld, which may occur if there is much difference in thickness between the body tube and safe end.

The recent application of electric buttwelding to safe ending is worthy of consideration. The important advantage is that the metal away from the weld is not so readily overheated. The process appears easy to control, is economical and should give a continuous, fine-grained structure throughout the weld. Some laboratory tests recently made show electric buttwelds made at the Norfolk & Western shops to have 90 per cent of the strength of the material itself. This railroad has for some time past been using this method of welding on safe ends and with very satisfactory results, attracting the attention of the mechanical officials of a number of other railroads, who will in all probability soon adopt this method.

* A paper presented before the St. Louis Railway Club.

Railroad	Material Installed	Water Conditions	Length of Service	No. Discarded		Cause of Rejection	Remarks
				Steel	Iron		
A	Charcoal iron and lapweld steel tubes in opposite sides of same engine.	Not stated	14 months	14 out of 176	49 out of 176	Pitting	
B	Tests made on three engines using half-sets of lapweld steel and charcoal iron tubes on each engine.	Bad	Three years (3 re-settings) Test continued	None	None		Steel tubes are in as good condition as iron. Tubes still in service.
C	Charcoal iron and lapweld steel.	Very bad	60,000 miles	25	75	Pitting	Engines in which iron and steel tubes were used were in same service under same conditions.
D	Tests made on one engine, using lapweld steel tubes on right side and charcoal iron on left side.	Bad	11 months (Test continued)	3	6	Pitting	Tubes removed and examined after 11 months. All put back in boiler except 9 which were discarded.
H	Ingot iron and lapweld steel tubes.	Bad	Iron—15,000 miles Steel—30,000 miles	3%	All scrapped	Pitting	
I	Swedish iron and lapweld steel in opposite sides of same engine.	Very bad	14 months (When examined)	None	All scrapped (One at end of eight months)	Pitting	They report that 18 to 24 months' service is obtained from steel; best service from charcoal iron was 12 to 14 months.
E	See "Remarks."	Extremely bad	See "Remarks"				Now using lapweld steel tubes on this division and obtain 25% more mileage and have less pitting than with charcoal iron.

Table 1—Service Corrosion Comparisons.

Nearly 90 per cent of the locomotives in America are now equipped with steel safe ends, although some railroads adhere to the use of charcoal iron body tubes carrying steel safe ends. The reason for this apparent inconsistency is not plain, for it is the safe end that must endure the most severe service.

With respect to durability in the flue sheet, there is abundant evidence on record to show that the mileage made with steel tubes is considerably greater, under the same service conditions, than with charcoal iron. In the tables are given some comparative figures on the corrosion of iron and steel tubes, and the mileage obtained in actual service of various railroads, which are indicated by letter. One of the most remarkable examples of unbroken service, probably the greatest tube mileage made in America, is shown by the Lehigh Valley in fast passenger service. Engine No. 2479, pulling an average 450-ton train, during 28 months completed in June 1913, ran a distance of 245,675 miles on one set of lapweld "Spellerized" steel tubes.

After testing out, side by side in service, the two classes of tubes, charcoal iron and steel, the leading railroads now recognize the value of the steel tube in service, the saving in shop work, and the great economy in first cost and increased mileage.

In this paper it is the desire to present the facts, both from a theoretical and practical standpoint, pertaining to the relative value of iron and steel boiler tubes as gained from the experience of manufacturer and consumer, all of which points to the one conclusion that steel tubes will ultimately replace iron, just as this material has displaced iron in other parts of boiler construction.

Many of you undoubtedly are familiar with the manufacture

Railroad	Mileage		Water Conditions	Remarks
	Steel	Iron		
A	101,000 (One engine)	50,000-60,000 Was considered good	Not stated	Test made on one engine equipped with lap-weld steel tubes under same conditions as the charcoal-iron previously used.
C	95,000 (Average)	46,000 (Average)	Bad	Engines equipped with lap-weld steel tubes tested in comparison with engines equipped with charcoal-iron tubes under same conditions.
B	80,500 (Average)	40,000 (Average)	Probably most severe in country	Tests made on engines equipped with lap-weld steel tubes under same conditions as the charcoal-iron previously used.
F	70,000 to 75,000 100,000 to 125,000*	Freight 20,000 to 25,000 Passenger 40,000 to 50,000	Not stated	About three years ago the use of charcoal-iron tubes on this railroad was abandoned in favor of steel tubes after comparative tests on these two materials.
G	78,000 (One engine)	40,000 to 50,000 (Average)	Not stated	Tests made on engine equipped with lap-weld steel tubes under same conditions as the charcoal-iron previously used. Tubes still good and in service.
H	Test on engine equipped with Swedish iron on one side and Shelby seamless tubes on the other side of same engine.		Not stated	After 13 months engine was shopped. Nearly all beads on Swedish iron tubes were in bad condition; those on Shelby seamless tubes were apparently as good as ever.

*One engine on this road in fast passenger service equipped with "Spellerized" lap-weld steel tubes made 245,675 miles before tubes were removed. This exceptional case is probably the largest tube-mileage ever made in America.

Table 2—Flue Sheet Practice.

of cold-drawn, seamless steel tubes, but probably few have heard anything regarding the manufacture of hot rolled seamless tubes, which is practically a new process, and I might devote a few minutes to explaining the manufacture of this tube, which like the cold-drawn is pierced hot, considerably larger than its finished size, then reduced by passing to a series of rolls, each roll reducing the tube both in size and thickness of wall. Small gas furnaces are placed alternately between rolls, which, as tubes pass through, keep up the temperature adaptable to the working of the metal, and the tube is, practically speaking, finished at the same degree of heat it was started with. Then it is allowed to cool gradually, and in this way is annealed throughout, which gives us a very soft and uniform material.

It is a well-known fact that hot metal will gather oxide from the air, which is beneficial to the material. In this case, while tubes are passing from one roll to the other, they are coated with oxide, which is worked into the surface of the metal by the rolls, and forms a protection to the tubes, whereas, when tubes are drawn cold, all of this oxide is removed while drawn through the die, or in other words, the surface of the metal is removed, which in all cases is a protection to any material. In my opinion, the only reason a tube was ever drawn cold, was to insure a uniform gauge. The finishing of a seamless tube hot is, I might say, of recent date. The process has been perfected, however, so that we can finish a tube hot and get a uniform gauge throughout. This being a fact, there is no good reason why the material should be worked cold, which cannot be of any benefit to the material. All of our tubes are made of basic open-hearth steel and will give equally good service.

I will say, from a practical standpoint, that a great deal of your tube troubles on the road are due principally to the water; it starts through the ingredients in the water, and that starts in turn the tubes to leaking.

One of the most important things is proper care of the locomotives in service, such as washing, and in carefully cooling them off.

Another thing is misuse and abuse of the locomotive, as we term it, on the railroad. An engineer can be of the greatest help in the way of increasing tube mileage on a locomotive; in fact, after the tubes have been properly set, it is up to the engineer to help take care of the flues.

I might say that I do not care how good a set of tubes may be installed in a boiler, without the engineer's assistance you will not get the expected mileage out of the tubes. I always lay great stress on the pumping engines which should never be done while standing still, if it can be possibly avoided.

Another thing is where the engine is worked very hard with the injector shut off; that will have a tendency to bring boilers to a very high degree of heat, and then engines are allowed to stand on side track with the injector working. The cold water will rush to the bottom and cause a sudden contraction, and the sudden contraction is what loosens the tubes, and then you have them leaking.

Another thing is in connection with the engine going over the cinder-pit. If I were in authority, I would never allow an engine to be pumped, if it can be avoided—from the time it lands in the yard and is relieved from the train, until it is under steam again. If an engine is placed on the cinder-pit with three gauges of water, it will not be necessary to again put water in the boiler until engine is fired up and again under steam.

The water is not in circulation when the engine stands still, and the cold water will rush to the bottom and strike the back flue sheet, where the boiler is hottest, and there is a sudden contraction, and that is what causes trouble.

The Oregon-Washington Railroad & Navigation Company will construct a roundhouse for 30 locomotives, and additional freight handling facilities at The Dalles, Ore.

Preliminary plans have been completed and surveys are being made for proposed construction of eight or more bridges over the O. W. R. & N. R. R. Co. crossings at Portland, Ore., by the city bureau of bridges and highways.

THE MALLET LOCOMOTIVE IN FREIGHT SERVICE.*

By J. F. Walsh.

In this paper I wish to give you an outline of the efficiency we accomplished on the Chesapeake & Ohio by the introduction and substitution of the Mallet type of locomotive in place of the ordinary Consolidation locomotives in heavy freight train service.

With very rare exceptions, until the Mallet type of locomotive was introduced on the Chesapeake & Ohio as a through freight engine, it had been used almost exclusively as a pusher, or helper, locomotive on heavy grades; but in view of the fact that over 70 per cent of the freight tonnage on the Chesapeake & Ohio is coal, which carries with it a very low rate, and in view of the continued increases in expenses, it became necessary to increase the train load in order that there might be left at least a small margin of profit. It was, therefore, concluded to order a sample Mallet locomotive to determine what results we could get from it in our through freight train service. The results obtained were so favorable that in a few months we placed an order for 24 additional Mallet locomotives. By the introduction of the Mallet locomotives we accomplished a saving of 5.712 cents per 1,000 ton miles, or 37.55 per cent in the case of handling the freight traffic on the Hinton division where those locomotives were placed in service.

The Mallets hauled a 70 per cent greater average train load than the Consolidations at the same average speed of 17 miles per hour.

The 25 Mallets replaced 44 Consolidation locomotives which handled the same volume of traffic. This resulted in the reduction in the number of trains daily over the division to the number of 17. This result effected also a reduction of 27.6 and 42.6 per cent, respectively, in the cost for wages of engine and train crews per 1,000 ton miles, as well as greatly simplifying the various transportation difficulties. The saving in the wage item alone amounted to over $6,800 per month.

Because of the additional economy obtained with the superheater and brick arch in combination with the compound cylinders, the Mallets saved 43 per cent in coal per ton mile over the Consolidation type engine. This means that the Mallet will burn no more coal than the Consolidation engine in doing 75 per cent more work. In other words, the fireman's work on the Mallet was no harder on the average—probably easier as far as coal shoveling was concerned—than on the Consolidation locomotives. In addition to these important results, 70 per cent more traffic could be handled with the same track facilities then existing, by the use of the Mallets. The opportunity offered by the increased power available in the Mallet type of increasing the capacity of the division or relieving existing congestion of traffic without the construction of any additional new track, is an advantage which would probably bear the greatest weight with the operating officials of railroads.

In the case at hand, for instance, 41 freight trains were run daily over the division with the Consolidation locomotives without exceeding the maximum track capacity.

The reduction of over 5 cents per 1,000 ton miles in the cost of operation is quite impressive when it is considered that on the basis of the traffic on the division where these Mallets were operated it would mean a net saving, all things considered, equal to the interest on $1,500,000 of 5 per cent bonds.

Assuming that the total cost of 25 Mallets would be $125,000 more than the cost of the 44 Consolidation locomotives which they replaced (it is certainly not a low estimate), and at 13 per cent yearly for interest and depreciation, this would amount to an additional fixed charge of $16,250 per year. The items comprising the cost of operation of the two classes of locomotives were prepared from carefully kept, accurate records, permitting of fair and reasonable comparisons, and covers a period of eight months from February 1, 1911, covering the time that the 25 Mallets were in service on the Hinton division. The item maintenance, in each case, includes only running repairs. It will be noted in the following table that the decrease due to Mallets is .05712.

*A paper presented before the Cincinnati Railway Club. Nov. 10. 1914.

COMPARISON OF COST PER 1,000 TON MILES OF MALLETS AND CONSOLIDATIONS IN ROAD SERVICE.

Item.	Cost Per 1,000 Ton Miles With Mallets	With Consolidations
Fuel	.0285	.05
Wages, engine crew	.034	.047
Wages, train crew	.031	.054
Maintenance (running repairs only)	.00012	.0009
Roundhouse expense	.0002	.00015
Supplies	.00009	.00006
	.09499	.15211
Decrease due to Mallets	.05712	

As mentioned above, the introduction of the Mallet locomotives on the Hinton division of the Chesapeake & Ohio followed directly from the successful performance of the single locomotive of that type which was purchased from the American Locomotive Co., and which, as mentioned above, was purchased for trial purposes with a view of determining the adaptability of the Mallet as a road engine.

At that time the freight traffic, which largely consisted of coal, with a scattering of lumber and general merchandise, was being handled by the Consolidation locomotives having a total weight of 194,000 pounds, cylinders 22 inches in diameter by 28 inches in stroke, and a maximum tractive power of 41,140 pounds.

A comparison of the principal dimensions of the Consolidation and the Mallet locomotives is as follows:

COMPARISON OF PRINCIPAL DIMENSIONS OF MALLETS AND CONSOLIDATIONS WHICH THEY HAVE REPLACED.

	2662 Type Mallets	280 Type Consolidations
Weight on drivers	337,500 lbs.	176,200 lbs.
Weight on leading truck	23,500 lbs.	21,100 lbs.
Weight on trailer	39,000 lbs.	....
Total weight of locomotive	400,000 lbs.	197,300 lbs.
Weight of tender	163,000 lbs.	131,700 lbs.
Wheel base, rigid	10 ft.	17 ft.
Wheel base, driving	....	17 ft.
Wheel base, total of engine	48 ft. 10 in.	25 ft. 3 in.
Wheel base, total engine and tender	80 ft. 9¼ in.	56 ft. 6 in.
Cylinders, diameter and stroke	22, and 35 x 32 in.	22 x 28 in.
Driving wheels, diameter	56 in.	56 in.
Boiler, outside diameter at front end	83⅞ in.	70 in.
Boiler, working pressure	200 lbs.	200 lbs.
Fire box, length	108⅛ in.	90 in.
Fire box, width	96⅛ in.	75 in.
Tubes, number	244–2¼; 36–5½	329 in.
Tubes, diameter	2¼ and 5½ in.	2 in.
Tubes, length	24 ft.	14 ft. 9 in.
Heating surface, tubes	4674 sq. ft.	2527 sq. ft.
Heating surface, fire box	344 sq. ft.	157 sq. ft.
Heating surface, water tubes	23 sq. ft.	26 sq. ft.
Heating surface, total	5041 sq. ft.	2710 sq. ft.
Superheating surface	911 sq. ft.	....
Grate area	72.2 sq. ft.	46.9 sq. ft.
Tender, water capacity	9000 gals.	7000 gals.
Tender, coal capacity	15 tons	10 tons
Maximum normal tractive power	73,200 lbs.	41,140 lbs.
Maximum tractive power (working simple)	87,800 lbs.	

Most of the loaded freight movement upon which those engines operated was eastward from Hinton, W. Va., where the ruling grade is 30 feet to the mile and about 13 miles long. After passing Allegheny it is practically all down grade into Clifton Forge; 15 miles of this being a descent of 60 feet to the mile. The average tonnage of the Consolidation engine eastbound out of Hinton was 1,850 tons—with the Mallet locomotive the average tonnage eastbound out of Hinton was 3,700 tons.

With the original sample Mallet locomotive we carried a boiler pressure of 225 pounds. When the additional 24 Mallet locomotives were ordered they were equipped with the Schmidt superheater, and the boiler pressure therefore was reduced to 200 pounds. As a result of the reduced boiler pressure the maximum normal starting tractive effort of the superheater locomotive was reduced about 8,800 pounds as compared with the saturated steam Mallet, though at the speeds at which the engines were operated the superheater locomotives seem to develop as much, if not more, power than the saturated steam Mallet locomotive which was shortly afterwards equipped with a Schmidt superheater, and the boiler pressure reduced to 200 pounds.

These Mallet locomotives, by the use of correct proportions and careful construction of details in combination with fuel saving devices of proven value, resulted in the maximum economy in operation of increased capacity per pound of fuel consumed.

From my experience as well as from continued close observation on other railroads using practically the same type of Mallet locomotives as is mentioned above, that type of engine is by no means either difficult to operate or maintain, as is quite generally supposed by railway operating officials.

They are not at all difficult to lubricate; although carrying a high boiler pressure with a high degree of superheat, we have no difficulty whatever in lubricating them with identically the same quality of Galena valve oil and lubricating oils as has been used for 30 years past upon saturated steam locomotives.

The ease with which Mallet locomotives start long trains has made them popular with officials in charge of the car department, as they are not nearly as destructive to draft appliances as the smaller types of locomotives.

They are also popular with the enginemen and firemen, and I believe, today, are the most practical, economical and useful locomotive for heavy train tonnage, and that their introduction on divisions of railways where the grades are heavy, or where exceedingly heavy train tonnage is to be moved, is certainly the proper move along the lines of that efficiency of which we hear so much.

On account of their unusual length, the weight is well distributed, and they are therefore no more destructive to roadbed and bridges than the ordinary Consolidation locomotive or smaller type of locomotives.

It should, however, be borne in mind that the Mallet locomotive is practically a double locomotive and that to obtain the best results from it much depends upon the attention the machines receive at roundhouse terminals. With very little additional cost they can be kept clean and made attractive to the man who operates them. One prominent railroad with which I am familiar makes it a practice to thoroughly wash them off with warm water after each trip. This leaves the machinery, as well as the upper works of the locomotive and the interior of the cab, clean, sanitary and attractive. The more attractive the machine is kept, the more interest the men who operate it will take in it and the more satisfactory results will be obtained from the operation of it, all of which is along the lines of the much desired efficiency.

THE FIRST EXHIBITOR in the Transportation Palace at the Panama-Pacific International Exposition to erect the building in which its exhibit will be made is the Western Pacific-Denver & Rio Grande-Missouri Pacific-Iron Mountain System. The exhibit consists of an immense globe, 44 feet high and 51 feet in diameter. On the face of the globe is shown a map of North America, with the lines of the system from San Francisco to St. Louis traced and illuminated electrically. The globe stands on an imposing pedestal with arched entrances. Projecting between the entrances is the reproduction of a modern locomotive front, carved in the supporting base. Railroad tracks, car wheels, engine bells, curling smoke are some of the appropriate designs that go to make up the decorative features.

The Northwestern Pacific will erect a depot, roundhouse and shops at Willits, Cal.

Scrap Handling Plant, B. & A. R. R.

An instance of the greater attention now being paid by the railroads to the reclaiming of discarded material and obtaining greater revenue through the sale of materials unfit for further use, is afforded in the new scrap handling plant of the Boston & Albany at West Springfield, Mass.

The plant consists of a storehouse 25′ x 40′, with connecting shed 25′ x 50′ housing the motor driven tools. A high platform 10′ wide on the sides and 30′ wide on the end extends around three sides of the building. Beyond the 30 foot end of this platform, and level with the ground, extends a low platform 45′ wide and 200′ long, on which the scrap is sorted. This lower level platform is constructed of cinder and screenings and is composed of 15 long bins 10′ wide with a large bin 50′ wide in the center. A truck, for loading and unloading, extends the entire length of the platform, on each side, and a 5 ton gantry crane, running on rails laid on a continuous concrete foundation, 80′ on centers, for a distance of 400′, spans the entire layout.

The tools in the shed consist of a pair of Alligator shears, driven by a 7½ H. P. motor; a drop hammer, driven by a 7½ H. P. motor; one bolt threader and nut tapper and one magnetic chip separator. The latter two pieces of machinery are driven from a line shafting operated by a 7½ H. P. motor.

The gantry crane is a standard 3 motor, 5 ton capacity crane. The span of wheels is 80′ and maximum travel of hook from lower to upper limits is 22′. Clearance from under side of girders to base of rail is 22′. The wheel loading, with maximum lift, is 28,000 lbs. The main hoist is driven by a 22 H. P. motor and lifts at a speed of 40′ per minute. The trolley running on the bridge is driven by a 3 H. P. motor and travels at the rate of 125′ per minute.

The bridge is operated on the rails by a 22 H. P. motor and travels 200′ per minute. All motors are 2 phase, 60 cycle, 440 volt, and of the General Electric type. They are enclosed on four sides and top by galvanized corrugated iron with necessary doors for inspection.

The following points of construction of the gantry crane are of especial interest: The web plates of the box section girders are reinforced by heavy stiffener angles placed near the bridge drive motor and are connected by a diaphragm, preventing distortion of girders by motors or gears. The bridge motor is bolted in a horizontal position to a heavy structural steel bracket riveted to the girders. The motor gears are enclosed and run in self-oiling bearings. The cross shaft is of extra heavy steel and is sufficiently strong to skid the truck wheels with crane fully loaded, thereby preventing distortion in shaft due to careless handling. The shaft is supported at uniform intervals by adjustable split, babbitted bearings which can be removed without disturbing any other part.

The crane bridge girders are box section type, built up of two web plates, four heavy angles and universal mill top and bottom cover plates. The web plates are reinforced at frequent intervals by heavy vertical angles conected together by diaphragms to prevent vibration and diagonal skewing, when crane is started suddenly.

The bridge ends are built up of plates and angles. Heavy gusset plates connect girders and bridge ends and prevent girders from getting out of square. All connection holes were drilled and reamed after parts were assembled and squared and only finished body round bolts with lock nuts were used for connecting these parts.

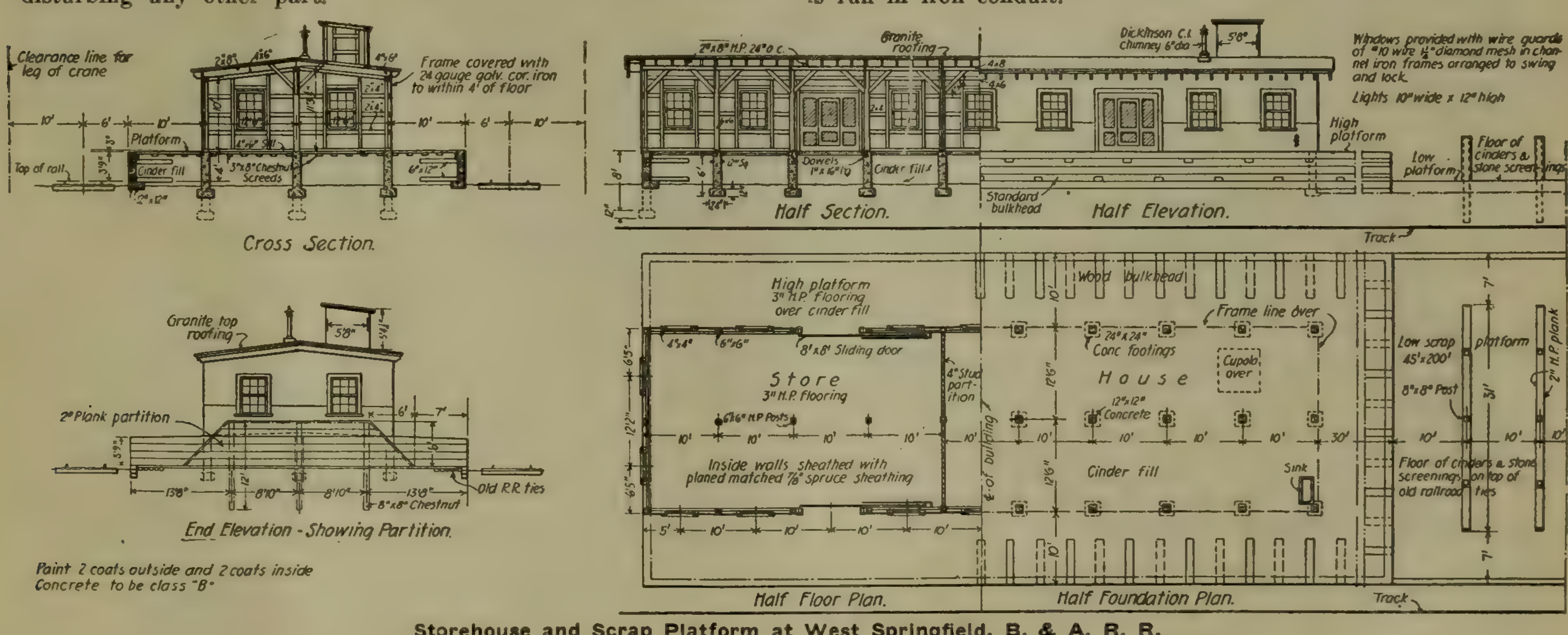
The truck wheels are extra heavy with double flanges, the treads being accurately machined or ground to equal diameters. The trucks are bronze bushed and revolve on turned steel axles of large diameter fitted in bored holes in the reinforced bridge ends and securely held by heavy plates. Bronze washers are provided between ends of truck wheels and web plates. The truck wheels may be easily removed by jacking up bridge ends sufficiently to remove weight from wheels, withdrawing axle and rolling out wheel.

The cross shaft is connected to the vertical shaft and the vertical shaft to the bridge truck wheels through the medium of cut bevel gears. The vertical shafts are carried in universal thrust bearings, making it impossible for the shafting and gears to get out of line.

The hook frame and yoke are of steel, having a factor of safety of 6 on all pats, which are accessible for oiling and examination. The extra heavy bronzed bushed rope sheaves are turned and grooved to fit rope and revolve on turned steel pins held in position by key plates, which are easily removed to permit the withdrawing of pin, which is drilled for center oiling. The hook revolves on hardened and grooved steel balls running between hardened and grooved steel plates.

The hoisting mechanism is controlled by mechanical load and electric brakes. Limit switch is provided for opening main current of motor to prevent crane from injury due to careless operation, if hook is raised to a dangerous height. A powerful foot brake of the post type is provided and is operated by a foot lever located conveniently in the operator's cage. The brake is simple in construction and extremely powerful in action.

The controllers are drum type with separate grid resistance, the operating handles being in convenient reach of the operator. The cage is equipped with slate switchboard having mounted thereon the four pole main switch and independent enclosed fuses for each motor and all necessary wiring connections. The conductor wires are stranded rubber covered cable of ample capacity. All wiring is run in iron conduit.



Storehouse and Scrap Platform at West Springfield, B. & A. R. R.

Scrap Platform, Bins and Crane, with Lifting Magnet, B. & A. R. R.

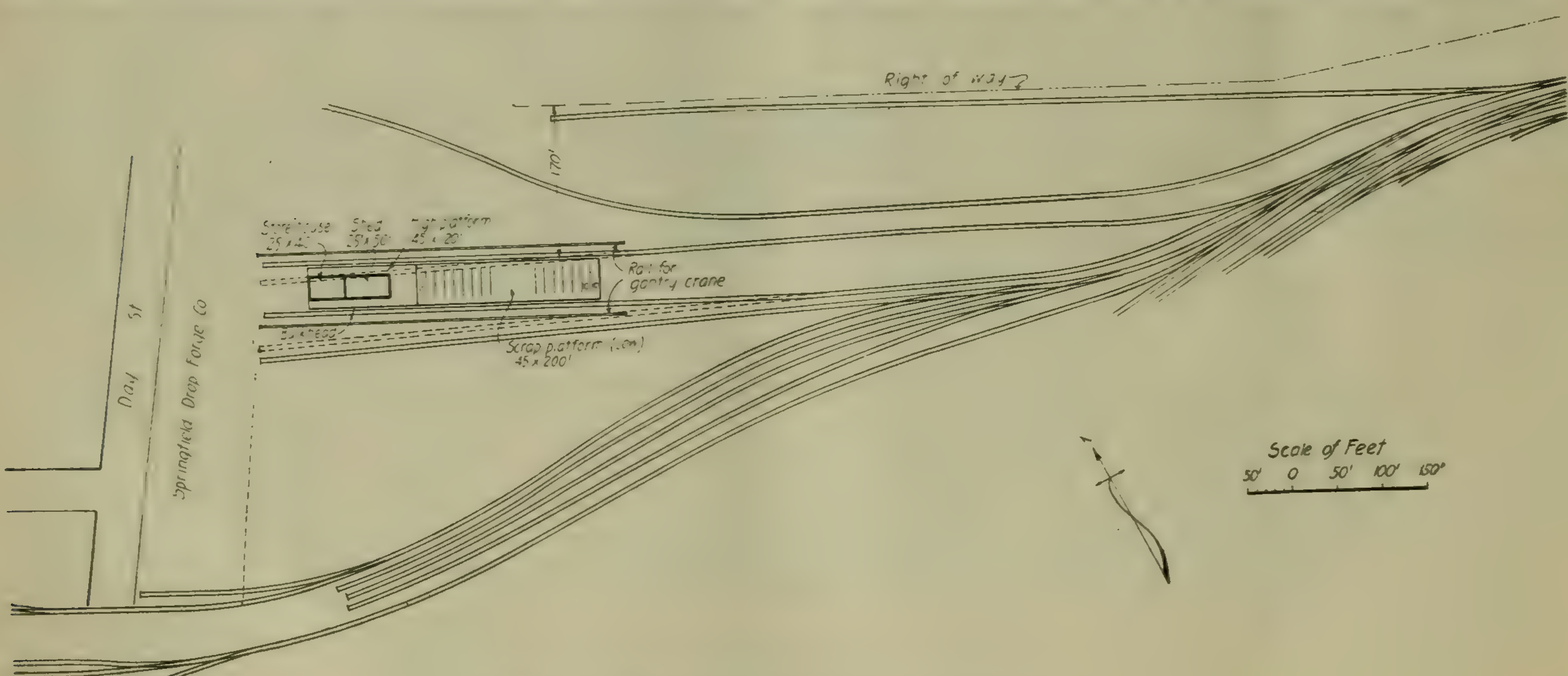
The operator's cage is built of heavy angles and plates and is thoroughly braced. It is connected with foot walks extending entirely across the crane on the bridge drive side, affording easy access to bridge motors, gears and bearings. The cage is covered with sheet metal casing and fitted with windows and a door. The foot walk is fitted with plank flooring, and angle iron toe guard and hand rail.

The lifting magnet is of 3,500 lbs. capacity and has a lifting surface three feet in diameter. The magnet is lifted by the hook of the crane, and when not in use is set on the platform. Direct current for this magnet is supplied by a 7½ KW 230 volt G. E. motor generator set bolted on the side of the bridge girders of the crane and controlled by the operator from the cage. Current consumed when lifting 3,500 lbs. is about 45 amperes at 230 volts.

Current for operating all motor driven tools, lifting magnet, gantry crane and also for lighting storehouse, shed and platform, is generated in the railroad company's power plant located about a quarter of a mile away. Current is generated at 440 volts, 2 phase, 60 cycle and is stepped up at the power house by transformers to 2,300 volts, transmitted to the scrap platform and again stepped down to 440 volts. The four trolley wires supplying current for all motors are No. 0 hard drawn round copper trolley wire. Wires are supported on 40′ wooden posts spaced 75′ on centers, wires being anchored to the end poles and supported on insulated spools on the intermediate poles.

Current for operating the gantry crane is collected by four small trolley wheels, each making contact with the under side of its respective trolley wire. Trolley wheels are supported on an insulated arm placed on the bridge girder, over the operator's cabin, the feed wires leading down to the main switch in the operator's cabin.

Although this new scrap handling plant has been in operation only since January 1st, 1914, a saving of 10c per ton on the



Layout of West Springfield Scrap Plant, B. & A. R. R.

handling of scrap has been affected. Prior to the construction of this plant scrap was sorted and broken by hand labor at West Springfield and at other points along the line. Under the present arrangement, scrap is forwarded to the scrap platform from all points and is there broken and sorted into bins awaiting sale or reclamation for further use, as the case may be. Under the old method, for a period of eight months, 9,748 tons of scrap were handled, compared with 19,196 tons of scrap for a similar period under the new method, showing a saving in favor of the new method of 21.6% in the cost per ton of scrap handled.

Comparing the use of the new gantry crane alone, with the old method of handling by manual labor and hand crane, for a period similar to that above mentioned, a saving of 63.3% in the cost per ton of scrap handled has been effected. In addition, the net value of material reclaimed from scrap and made fit for use,

Crane Operator's Cage and Method of Collecting Current. Storehouse in Background.

during the above period of time, amounted to over $1,000.00 more than the total cost of labor for running the entire plant, while under the old method practically nothing was reclaimed.

The reclaimed material consists of brake shoes, brake pins, brake levers, connection rods, couplers, follower nuts, washers, firehooks, bolts, spikes, side irons, tie plates, shovels, round and flat irons, etc.

The installation was made from plans prepared by the engineering department of the road, to whom we are indebted for the above information.

THE SITUATION IN BRIEF.

Railway operating income for September, reduced to a per mile of line basis and compared with that for September, 1913, shows a decrease of $3, or 0.9 per cent, while operating income per mile for September, 1913, showed a decrease of 81.1 per cent from that of September, 1912. Total operating revenues per mile for September decreased 6.0 per cent as compared with September, 1913, operating expenses per mile decreased 8.5 per cent, and net operating revenue per mile decreased 0.5 per cent.

The Southern will start work at once on new engine terminal facilities at Denverside, near East St. Louis, Ill., at a cost of about $275,000, and is asking for bids for the construction of an 18-stall roundhouse, shops and other buildings.

The Tampa & Gulf Coast which recently completed an extension to St. Petersburg is making plans to build a passenger station at St. Petersburg, Fla.

The Chesapeake & Ohio, the Southern and the Norfolk & Western, will build a reinforced concrete viaduct over the James river at Lynchburg, Va.

The McCormick Contracting Co., Easton, Pa., has been awarded the construction of an 800-foot dock adjoining the present up-river property of the Cincinnati, Hamilton & Dayton, at Toledo, O. The improvement will cost $750,000.

JOINT CAR REPAIR SHOPS.*

By F. C. Schultz, Chief Interchange Inspector, Chicago, Ill.

For a number of years I have been advocating the establishment of joint repair shops at large terminals to take care of foreign cars. Such shops should be established in districts in which a large number of industries are located. Loaded cars that arrive in these territories in bad order, and are unloaded, necessarily have to be returned to the delivering line for repairs. Such cars should be repaired in these districts and reloaded, thereby avoiding the hauling of the car back empty to the delivering line, and also creating a supply of good order cars for loading at industries in such districts. If such cars were repaired, it would also avoid the necessity of hauling of empty cars into these districts for loading, as the necessary supply would be created.

The available cars in the various territories for such joint shops, taking Chicago as an example, would amount to about 250 cars per day, including both light and heavy repairs necessary to put the cars in a serviceable condition for loading. In addition to the available cars that necessarily would accumulate in these territories, railroad companies should be permitted to forward to such shops, foreign bad order cars which accumulate in their terminals, so as to entirely relieve the railroad companies' shops from the necessity of repairing foreign equipment. It is a well known fact that car repairers working on cars owned by the road they are working for, are able to do a great deal more and better work than they are able to do when working on a miscellaneous lot of foreign cars. It is also far more economical to carry such necessary foreign material as is needed at a joint shop than it is to carry a supply at each of the shops of the various railroads entering into a large terminal.

The M. C. B. Rules which went into effect on October 1st, 1914, and in particular M. C. B. Rules Nos. 1, 2 and 120, have brought about the accumulation of a large number of foreign bad order cars which will have to be disposed of under the above mentioned rules, and if such repairs were made at a joint shop, a great deal of the material removed from the cars which the car owner orders dismantled under M. C. B. Rule 120 could be used when making repairs to foreign cars.

If joint car shops were established, an organization should be created to supervise the repairs made to such cars in the following manner:

First: To authorize repairs that are necessary by making an inspection of the cars.

Second: To see that the repairs are properly made.

Third: To see that bills are properly rendered for the work done, by billing against the car owner for owners' defects and the delivering line for delivering line defects.

The question will necessarily arise as to whether or not joint car shops, if established jointly by the railroads, will carry themselves and pay a reasonable interest on the investment. The present M. C. B. Rules covering labor and material, as I understand it, are worked out with this end in view, and I personally believe that the present M. C. B. prices are adequate to make such shops self-sustaining. One of the great advantages to be gained by having a joint car shop, would be the creation of a car supply, thereby saving a large amount of money, both in intermediate switching charges and per diem, which accumulates while such cars are being moved back and forth. The delay of moving such cars to repair tracks should also be considered: to illustrate—

A car moving under load from one railroad to another via a switching line to an industry, if found in bad order when unloaded is returned to the switching line for delivery to the originating line where repairs are finally made. A joint car shop would reduce the switching and make the car available for loading more quickly, as well as reduce the liabiltiy of damage due to accident on account of handling bad order cars.

The establishment of such shops would necessarily have to be under a corporation, the stock to be divided and held by the interested lines, as the proposition would be entirely too large to be handled on an assessment plan. In order to try out the

* A paper presented before the Car Foremans Association of Chicago.

feasibilities of establishing a joint car shop to work out the details, that it might be well to lease a shop at one of the large terminals, so that there would not be any necessity of advancing a large amount of money for the purpose of acquiring grounds, buildings, machinery, etc., which would be necessary to establish a new shop, and if the plan worked out in a very short period we would be able to determine as to whether or not this plan would be feasible and would be able to proceed on a more elaborate basis.

If the above mentioned trial at a leased shop, which may not be entirely up to date and modern, should prove advantageous and satisfactory, there could not be any question but that the operation of a modern shop would not only be practical but would be a good investment to the railroads.

Another matter that would have to be looked into, would be the question of the proper amount to be allowed to the terminal line for switching charges to and from such shops.

It is my understanding, that when a car is delivered to a switching line under load, a switching charge is made which carries with it the return of the empty car to the originating line. If this is correct, the movement of cars from industries, after the same are unloaded, to the shops for repairs would be about the same as though the cars were returned to the originating line empty, and switching charges should only be allowed for the service of switching the car from such shops after the repairs had been completed. This, however, would not apply to cars delivered empty to such lines by railroad companies for repairs at joint shops, and in such cases I presume separate rates would have to be made.

WILLIAM HALL, secretary of the General Foremen's Association, has changed his local address at Winona, Minn., from 914 to 1126 West Broadway.

CAR DEPARTMENT CORRESPONDENCE.*

By Frank Cleary, Chief Clerk D. L. & W. R. R.

Reviewing car department work in recent years, we become impressed with the apparent constant increase in correspondence incident thereto, and as we study the conditions we are led to believe that with due care and observance of instructions, some of it at least could be noticeably curtailed and a more pleasing condition brought about.

Time expended in correspondence should be used judiciously and as effectively as on any of the other features of car work, and if it is possible to clear the situation with one letter, do not permit oversights or errors to be the cause for writing two. We pride ourselves on our frugality in the use of lubricants and material of all kinds and in the manipulation of forces rendering as much result as possible, and why not now, of our own initiative, show our ability to cope with the needless correspondence situation.

Let us endeavor to follow the motto: "To Labor Less and Accomplish More." We are all aware that palpable errors are accountable for much unnecessary correspondence, and which of us is not aware of this annoyance invited by furnishing a wrong transfer or adjustment order, a wrong number or initial in connection with M. C. B. foreign repair bills or looseness in a report giving an account of a train accident. Allow me to cite an example of the latter.

A trainman makes a report of an accident to his train, involving derailment and damage, and assigns as a reason that a brake beam dropped down on one of the cars moving in his train. This report is accepted by his superiors as sufficient information as to the cause.

A car department man is instructed to make a report on this accident. He shows the numbers and initials of cars and parts of each damaged and assigns as the reason for the accident that

*A paper read before the Niagara Frontier Car Men's Association.

New Year's Resolutions, As Seen by the Cartoonist.

a brake beam dropped down, and this report is incomplete and unsatisfactory. He has failed in his mission—has caused delay to the report to the officials and has caused the writing of several unnecessary letters.

In order that his report will be acceptable from a car department standpoint, it must show the cause of the brake beam dropping down. This may be a broken brake head, brake hanger, track conditions or the absence of cotter keys, allowing the displacement of bolts. It must show also whether the originating or initial defect was entirely new, occurring in movement, or partly old, and whether the defect could or could not have been detected by the inspectors through which the car passed.

In like manner a trainman reports an accident and assigns a broken wheel as the cause. The car department man to meet the requirements goes into detail showing the cause of the wheel breakage, such as a prolonged application of the brake, a worn flange or a seamed tread. He also shows the name of the manufacturer and the date. Also arranges for proper inspection of triple and retainer under certain conditions. Should he fail in any particular, he contributes the usual amount of unnecessary letter writing. Reports of this character should be made with the least possible delay and by all means before letters of inquiry from our officials are necessary.

This and all correspondence possible should be handled without the necessity of inquiries, and strange to say we are generally able to make reply to an inquiry on the day we receive it, whereas the original should have received this attention.

It may appear from this that more is expected of the car department man than from the trainman. This is not so. The nature of this work in the department that he is engaged in demands that special information mentioned be furnished.

I will now approach the wider field of error and the one that furnishes its full quota of unnecessary correspondence and tracing —the work of rendering foreign car repair bills—and we need consider but one feature of this to account for numerous letters and corrections, "Wrong Numbers and Initials."

We will assume that we have several reports of repairs returned to us as it proves that the car record office could not locate any movements of the cars on the line about the dates that reports show repairs to have been made. We ascertain that corrections must be made which generally will run along as follows:

We find that the initials reading N. Y. C. & St. L. should read N. C. & St. L.; N. Y. C. & H. R. should read N. Y. C. & St. L.; C. M. & St. P. should read C. M. & P. S.; C. R. I & P. should read C. R. I. & G.; Can. Pac. should read Central Pacific, and numerous others along this same line, which occurs through a similarity in the initials, but the wrong recording is by no means justified and with ordinary care could be entirely avoided.

Add to this the wrong number feature, such as 7715 should be 7751, and you have the situation complete with the exception of the equipment bearing numbers of six figures introduced of recent years and which has a tendency to increase the wrong number taking.

You will observe that the wrong initials prove the greater source of annoyance, as this means a correction in the amount of the bills made up which is not occasioned by wrong numbers. Considering the errors in repair bills other than those occasioned by numbers and initials, we find that the Master Car Builders' code of rules, which form the basis of all such charges, have grown from a simplicity to a rather arduous task, requiring close scrutiny and precision in making proper charges of owners' defects and requires ability and experience to recognize the outlines of what constitutes combination of defects denoting rough handling. Still the foreign repair bills corrected for errors of this nature are comparatively few to the corrections made for wrong numbers and initials, the latter work having remained as simple as it was at the inception of the rules and again the evidence is furnished that carelessness is responsible for errors and subsequent loss of labor in making corrections. The great care to be exercised and study required in making foreign repair bills according to the present code and the ever increasing danger of errors, due to the many changes introduced from year to year leads me to believe that a biennial change of the rules would be desirable, were it not that perhaps more weighty reasons demand the annual change to meet the carrying requirements of this most advanced age of car building and transportation.

It may appear to some that the difficulties outlined thus far have been overdrawn or that recourse was had to imagination to produce the conditions described. However, I believe on close observation that it is simply a fair representation of what is going on around us on all lines and I am satisfied that it has assumed its present proportions through lack of care on the part of employees taking numbers and initials from the cars and by men in supervisory positions not offering any criticism to the individual responsible at the time corrections are made. By making corrections without the knowledge of the responsible party and allowing him to continue paves the way, not merely for a continuance of this annoyance, but to an increase, making the conditions chaotic and unwieldy.

It is such an easy matter with some little care and attention to perform the work of handling numbers and initials correctly that continual failure on the part of those engaged in doing it would be accounted for by the absence of supervisory attention on the part of men directly in charge of the work. Of equal importance with the repair bill condition is the work of transfer and adjustment orders and defect cards as established under our Niagara Frontier Association rules and many indeed are the avenues of error in the performance of this work.

A receiving line's inspector issues a delivering line's defect card and is informed in due time of tracing that it has been improperly issued and that it should have been issued against some other line and the inspector being questioned, explains it by showing absence of symbol marks indicating the delivering line and as symbol marking is part of the system of the Frontier Inspection, no member of the association should be required to adopt extraordinary methods to arrive at proper deliveries but by the expected co-operation of the delivering line, receive the needed information to transact business properly and promptly and not be required to perform the needless work of corrections of the items referred to.

Let us have some concern for the arbitrator and his office who make the defect cards and transfer orders bona fide by their "O. K." stamps, but who have not within reasonable reach, the records of the various lines to test the correctness of car numbers, initials or deliveries and are therefore depending solely on the forces of each individual line to make accurate reports and avoid complications which if allowed to continue, will mar the name of the most progressive system of freight car inspection known—the Niagara Frontier Car Inspection Association.

I have referred to the difficulties in preparing foreign repair bills and the liability to error, etc., but this was chiefly from a clerical standpoint.

Let me now call your attention to the work of issuing defect cards and keeping them well within the spirit of the Master Car Builders' code of rules, covering the issuance of same and which appears to be the greatest difficulty in the matter at present. I have reference to defects upon which inspectors' opinions and may I say foremen's opinions differ as to whether they are sufficiently extensive to require a defect card or not. And while we know that good effort has been put forth by the arbitrator and foremen in instruction and personal appeals that the judgment of inspectors might become uniform and universal, still we know that a margin of difference of opinion still exists and causes its share of correspondence in an endeavor to straighten out each individual case. But while we wish for the time that inspectors will agree more closely on the subject and harmonize with the spirit of the Master Car Builders' rules, our hearts go out to the man with hook and chalk who struggles from day to day with the embarrassing question, "what constitutes a defect too slight to require a defect card?"

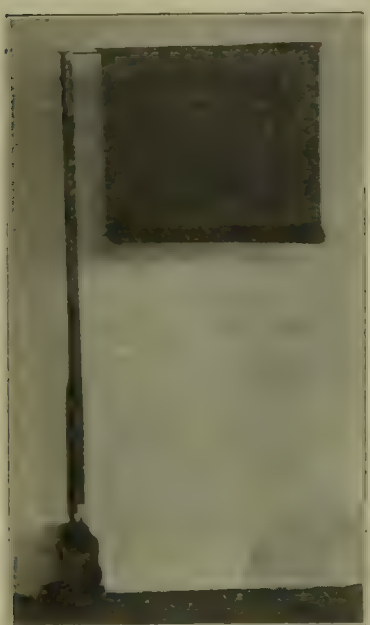
In conclusion, let me say that the foregoing does not embody all the difficulties we have to contend with in car department

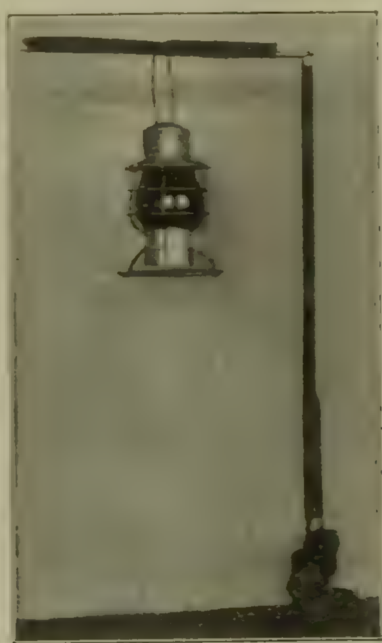
correspondence but they represent some of the cardinal features that lead to useless labor and the elimination of them may lead to improvements generally.

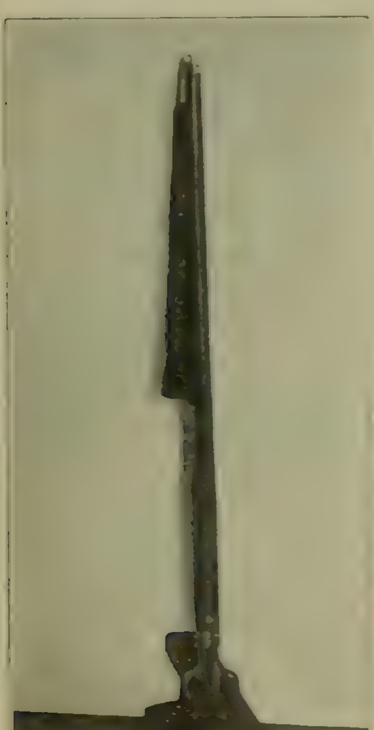
There is work for all in bringing about the desired result. Let us educate, co-operate with and encourage those about us who may be in need of our assistance to the end that as a department force not as individuals our service may become most effectual and satisfactory.

BLUE FLAG HOLDER.

The car department of the Canadian Pacific is using a blue flag holder that appears to meet all requirements, the appearance and general construction of which are shown in the illustration. The sizes of materials used are as follows: the spring clamp for gripping the rail head is made of one piece of ⅝" half round, the footpiece used for forcing the clamp over the rail is 1½"x⅛"x4½", the mast is made of 1¼" O. D. seamless tubing, 1/16" thick, 32" long. This is cylindrical for a distance of 9" from the lower end and above this point one side is pressed in so that the cross-section is crescent shape, thus forming a recess that permits the flag when wrapped around the cross bar to be folded so that it is very compact and convenient to carry. The flag is secured to the cross bar by means of a light strip of metal and four small stove bolts, and the lower edge of the flag is weighted with a piece of steel bar, thus ensuring the full area always being in view regardless of wind conditions. This is an important feature as the ordinary flag attached to a perpendicular mast hangs limp when the wind is not blowing and if attached to a stick that is horizontal, the flag may not be very conspicuous if the wind is blowing strongly from the direction of the observer.


Arrangement In Daytime.


Arrangement At Night.


Flag Holder Ready To Carry.


Spring Clamp Withdrawn from Clamp, Ready to Apply to Rail.

At night it is equally as useful as in the daytime, the only change required being to wrap the flag around the cross bar and hang a lantern over the bar, the folds of the flag serving to prevent lantern from creeping off.

One of the most important advantages of this arrangement is the fact that makes possible the enforcement of rules requiring that flag be located a specified distance away from the car that it is protecting. This is important, as flags displayed against a dark object, like a car painted black, are not as conspicuous as they would be if placed some distance in front of same.

McKEEN SWITCHING LOCOMOTIVE.

The Motley County Railway recently purchased a 300-horsepower gasoline switching locomotive from the McKeen Motor Car Company, of Omaha, Neb. The locomotive made the trip, Omaha to Matador, Tex., under its own power and is used in freight and switching service between Roaring Springs Junction on the Quanah, Acme & Pacific and Matador, Tex. This locomotive has a tractive effort of 12,000 pounds at 6 M.P.H. The motorman's position in the center and on the right side of the locomotive with an uninterrupted view in all directions, which, together with the air reverse control, enables the execution of signals with quite superior facility to that of his contemporary, the steam locomotive engineer, whose vision or outlook is more or less restricted by the boiler and tender. Of the general features only the cab resembles the 200-horsepower locomotives built by the McKeen Motor Car Company, the 300-horsepower design being in the 0-4-2 class.

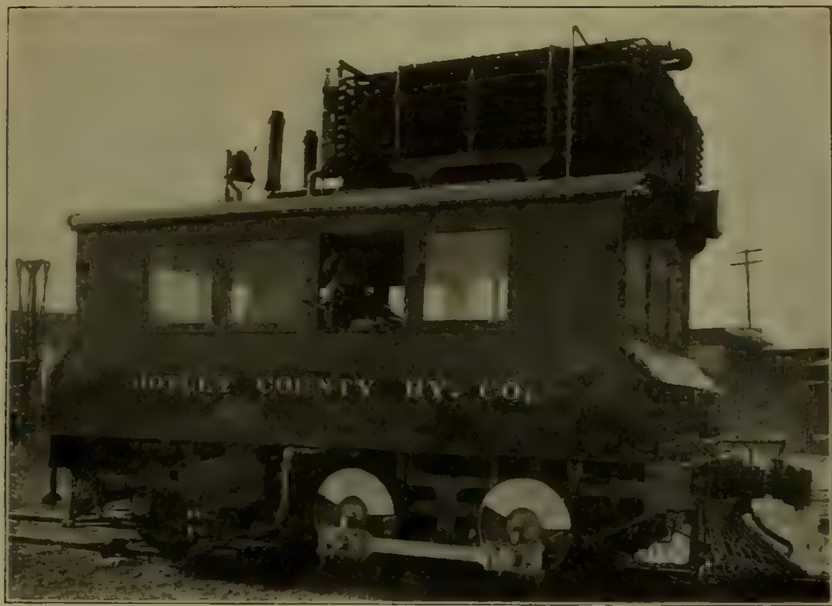
The frames are of cast steel and the driving wheels are 42 inches in diameter. The engine bed is a steel integral casting forming an efficient brace and reinforcement in tying together one side frame to the other.

The cab, an all-steel structure, covers the entire length of the locomotive frame between the bumper beams and is so bolted to the frames and buffer beams as to add very materially to the strength of the locomotive. All equipment, accessories, etc., in the cab are conveniently located and do not obstruct the motorman's view in any direction. The headlights are operated by acetylene. Straight air brake is used on the locomotive, which has a Gregory brake valve permitting the operation of automatic brakes on train.

The diameter and stroke of the internal combustion six-cylinder engine is 11 in. and 15 in. respectively, the general design and details corresponding to the McKeen Motor Car Company's latest model. Among the new characteristics is the use of two exhaust pipes, which extend through and above the roof. The engine is equipped with an air-reversing mechanism which adds materially to the convenience and ease of the motorman. Two 5-in. air compressors are attached to the engine crank shaft, in addition there is an auxiliary air compressor in the cab for emergency service.

The ends of the front or main driving axle and rear driving axle have counterbalance crank discs which are connected by side rods.

The power transmission, pneumatically operated, is effected by means of sprocket on the crank shaft, through a Morse chain to a sleeve working free on the rear driving axle, and is then transferred through a multiple disc friction clutch, from which it is delivered by a Morse chain to the forward driving axle where, by an octoroon clutch, the power is either magnified by a series of gears to produce heavy tractive effort and high torque for starting purposes, or is delivered direct to the driving wheels. By thus magnifying the torque of the internal combustion engine great starting effort is obtained for this style of locomotive. At the same time the locomotive once in motion, the higher



McKeen Gasoline Switching Locomotive.

economy is obtained by cutting out the gears and operating the direct connection. This is a very simple mechanism, the motorman's control of which is much more convenient than that of steam locomotives.

UNITED STATES SAFETY APPLIANCE STANDARD.*

By R. M. Berg, Inspector of Contract Work, L. S. & M. S. Ry., East Rochester, N. Y.

The topic of "U. S. S. A. Standard" is very near to each one of you or should be, on account of the great pressure being brought to bear upon it by the Interstate Commerce Commission. It is not my intention to try to tell you what is the interpretation of each one of the statements given to us in that act, however, but it will be my endeavor to bring back to you the advancement and reasons for this act as it comes to me in looking over Government reports and to recall to you in a way, why safety appliances have become standardized.

In the early stages of railroading, the equipment of the different concerns was but a matter of conjecture to the individual heads of that road, and, as railroading was but in its infancy, interchanging of its own equipment with that of another road was not thought of, and the necessity of standard equipment, as well as rates, was not needed; but as the commercial possibilities grew it became necessary to bring this equipment and the rates to a standard whereby delay in the transporting of commodities would be eliminated and the public given better and more evenly rated service. Having grown from a private business to one of national scope, the railroad affected the people more directly than before as it became a necessity. This brought about Federal action and the Interstate Commerce Commission was appointed to regulate commerce and that which appertains to it.

Freight equipment was being damaged, the lading lost or demolished and the numerous accidents, caused the Interstate Commerce Commission to co-operate with the more aggressive roads, and in 1895 the standard height of draw bars was given out after consulting with the American Railway Association. In 1898 it became necessary to have all trains engaged in interstate commerce equipped with fifty per cent automatic brakes, amended in 1910 to read at least eighty-five per cent; the locomotive to be equipped with automatic driving-wheel brakes. Along with this came the automatic couplers, and as a matter of safety, grab irons or hand holds were required to be securely fastened to the ends and sides of cars.

The rapidly increasing business was so great; causing accidents with such rapidity on account of the inefficient appliances provided to protect the employee, that the Interstate Commerce Commission had to again assert itself and co-operate with the employee, as well as the employer, and established in 1911 a set of dimensions and clearances for freight equipment that would govern all common carriers engaged in interstate traffic.

* A paper read before the Niagara Frontier Car Men's Association, September 23, 1914.

In compiling this code, it was apparently their idea to place on only such appliances as would be of need to protect the life and limb of the employee and yet not encumber corporations with an unnecessary expenditure of money.

While I am not an authority as to the exact reasons given for each dimension and clearance, deduction points towards a few of them as follows:

"Hand-brakes shall be of an efficient design and work in harmony with the power brake." Should it not work in harmony a separate set of brakes would be necessary.

"The brake shaft should not be less than an inch and one-quarter in diameter." An inch and a quarter was found to be the smallest practical diameter to withstand the maximum power to set the brakes with a small allowance for safety.

Welds, on account of the uncertainty of true welding, were impractical.

A fifteen-inch brake wheel was found to be of such size as to provide sufficient leverage to set the brake with the strength of an average man. Any other material, other than malleable iron, wrought iron or steel, would either not be of sufficient strength or would not be of enconomical value.

The location of the brake shaft is in such a position that it will not interfere with the efficiency of either the running boards, or end ladder.

A four-inch clearance around brake wheel being allowed as a minimum distance wherein a man can effectively operate the brake with efficiency and safety.

The one-half inch bolt used almost exclusively on safety appliances is such that will withstand a maximum strain expected of it in ordinary wear and tear of service allowing a margin for safety. This may also be said of rivets.

The brake shaft step, goose neck or stirrup, as it may be colloquially termed, being of "U" shape, entertains the greatest degree of efficiency, while setting the brake, it guarding against tangling up the brake chain.

The square fit at the top of brake shaft allows greater results by not permitting the brake wheel an undesired amount of freedom as is often found the case of a round fit. The taper of two in twelve being one of common use in mechanical work, was allowed so as not to permit the brake wheel to slide down on the mast. And so on with the rest of the dimensions, all giving the maximum amount of efficiency at an economic cost.

Running boards are given a width that will allow a man to walk on without the necessity of stepping off when he becomes momentarily unbalanced by the motion of the car. The latitudinal one being wider, as it is placed near the end of the car and where one may become more affected by the height, also to cover extreme widths allowed for locations of ladder on side of car.

The nineteen-inch spacing of ladders is the average height of a man's foot from the floor when his knee forms a right angle.

The sixteen-inch length of tread is long enough to conveniently place both feet on the ladder-round without interference or extra precaution.

The eight-inch spacing from end or side of car to inside of ladder is a maximum distance to conveniently reach around from one to the other without stretching.

The end and side ladder rounds coinciding produce safety on account of the dependability upon where one is to step when he passes from one to the other.

A two-inch clearance is given because the length from the middle of the second phalanx of the middle finger of a man's hand is approximately one and one-half to an inch and three-quarters. The other quarter inch is allowed as a margin of safety, also it allows a depth great enough to secure foot hold.

Foot guards are applied to keep the foot from slipping off the ends of the rounds.

The end clearance of twelve inches allow a minimum space of twenty-four inches for a man to utilize to work in or in climbing an end ladder between two cars, should he be forced to go between them. Such is a minimum space used by the average sized man.

Roof hand holds are spaced between eight and fifteen inches,

on account of the average length of a man's fore-arm with fist doubled up being fifteen inches; eight inches allowing a more convenient distance with location such as to secure a safe application.

The location of side and upper end hand holds is such that it is in a line parallel to a man's head, a convenient distance for a man to reach without losing his bearing. The lower end hand holds being located in such position as to be easily accessible should a man be forced to use them while between cars. The additional end hand hold used with outside end sill is located at such a height as to be conveniently used in passing between two coupled cars.

These are a few of the deductions which have appeared feasible to me and I have found it a matter of great convenience when studying this act to couple these deductions with the figures themselves, they allowing me a basis upon which to work.

PORTABLE RIVETING STAKE.

By A. N. Lucas, Genl. Fmn. Boiler Wk., C., M. & St. P. Ry.

I am sending you herewith photograph and blue print of what we call a portable riveting stake. This for general use in boiler shops and made up especially to take care of sheet iron work, such as petticoat pipes, pump and stationary stacks, roundhouse jacks, firebox door shades and cylinder casings. Every boilermaker throughout the country will understand the benefit of having a good riveting stake that is ready for use at all times.

Portable Riveting Stake.

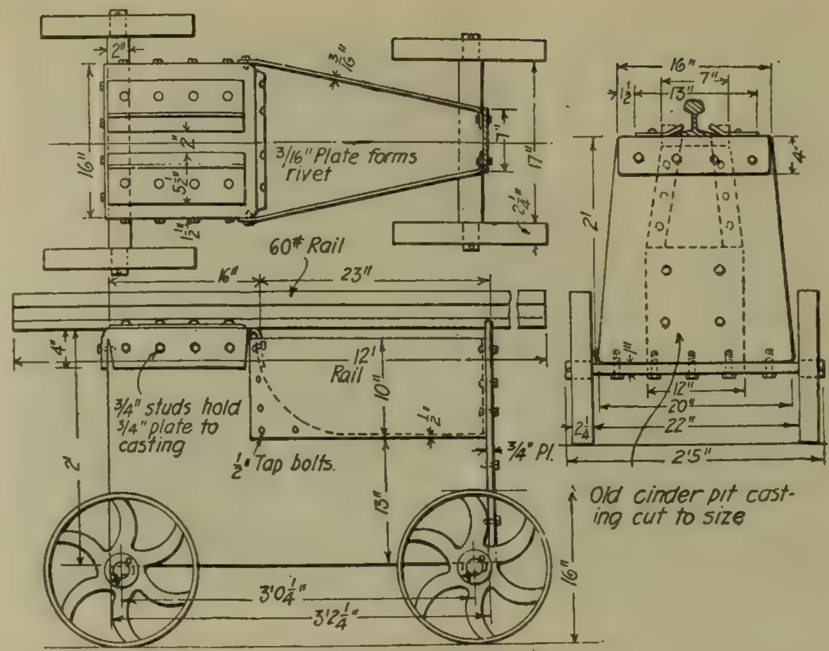
In a large number of boiler shops very little attention has been paid to riveting stakes. Many times you will see a piece of rail lying across two horses with cast iron weight to hold same down, while men are working at other end. At other times you will see a piece of rail projecting from the end of a bench, or a piece of rail placed through a hole in the wall.

These methods often take up valuable shop room and also block up the gangway. Due to this fact we decided that a good portable riveting stake would be as handy a tool as we could have in a boiler shop, and by having same on wheels it could be moved to any convenient place in the shop. When the weather is fair it could be wheeled outdoors and used with just as good results.

In making up this portable riveting stake we used an old cinder pit casting, which weighs about 400 pounds. We cut this off to the required height, flanged a piece of ½" material to fit over the casting, and on top of this flanged plate we riveted pieces of steel offset so that a piece of 60-pound rail would pass through same readily. We then bolted the flanged piece to top of casting.

At the front end of the casting we applied a ¾" plate, bolting same on with tap bolts, cutting out top end ¾" deep and the width of bottom web of rail in order to act as a guide and rest to hold rail up and in place at all times. We then applied sheet iron plates on both sides, as shown in the illustration, which gives us a box to care for our rivets, drift pins and bolts.

By using rail 10 or 12 feet long we can use a man at both



Portable Riveting Stake.

ends of the stake without having them interfere with each other at all, and the best of all is, there is no danger, for you cannot tip it over on account of the weight of the casting and its construction.

It is right in line with the "Safety First" movement, where with the old methods, weights and horses were continually falling and getting out of place. It can be readily moved around by using the rail as a lever.

RAILWAY FATALITIES as reported by the Interstate Commerce Commission for the months of January, February and March, 1914, show quite a material decrease over the figures for the corresponding period in 1913. The passengers killed, all causes, number 52 in 1914 and 68 in 1913, for the three months mentioned. The grand total, for the period of passengers, employees, trespassers, etc., numbers 2108 in 1914 and 2341 in 1913. Of the first mentioned number, 1369 were trespassers, nontrespassers, employees not on duty, etc. These figures, of course, deal with steam railways only.

According to an order handed down by the Public Utilities Commission of Illinois, all industrial railroads in the Chicago shipping district are held common carriers and entitled to receive allowances and participate in the through rates of trunk lines. In common with other trunk lines the railroads centering in Chicago filed tariffs early this year, withdrawing all allowances for the switching services performed by the local industrial roads.

Several months ago the United States senate directed the Interstate Commerce Commission to investigate the relations between the Louisville & Nashville and the Nashville, Chattanooga & St. Louis. The Louisville & Nashville officials refused to allow the examiners of the commission access to the correspondence files on the ground that its files were private and contained communication between the railroad and its attorneys. Joseph W. Folk, counsel for the Interstate Commerce Commission, filed a brief on December 11, in which he contends that the federal government has the same power of visitation over corporations that the state has with respect to a franchise granted by the state. If this contention is sustained it would give the Interstate Commerce Commission the right to scrutinize all the business affairs of the railroads.

The Detroit, Toledo & Ironton will build a frame five-stall roundhouse with concrete engine pits, and a frame freight house 20 feet by 90 feet in area, and with a platform surface of 2,500 square feet at Delray, Mich. The work will be done by the company's forces.

The Iowa Railway & Light Co. will spend $500,000 next year for a new terminal station and depot and other improvements at Cedar Rapids, Ia.

Thirty-Ton Stock Cars, C. P. R.

Stock car construction, while at all times consisting of considerable variations in design of details such as method of securing the side framing to the side sills, etc., has always followed the same general lines of wooden underframe and decking with side posts and braces similar to box cars, but modified to suit the application of heavy slats on the inside only. When hay racks are used, however, it is customary to apply sheathing outside hay racks.

The fact that so-called stock cars are used for many other kinds of freight, such as lumber, rails, ties, pulpwood, pipe, etc., seems to have been ignored by many designers and builders. As a matter of fact, if a careful check was made on some roads they would find stock cars were used for this class of traffic considerably more than for live stock.

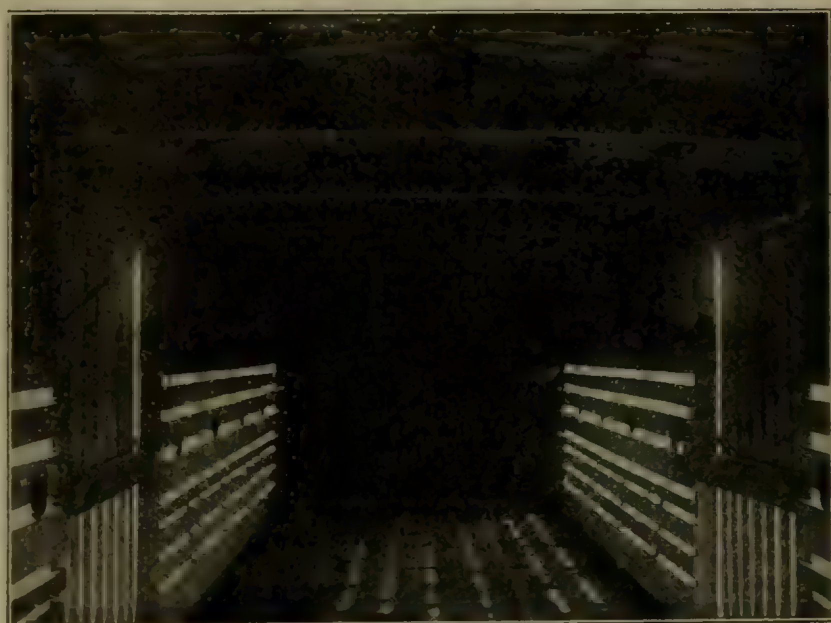
Even though the percentage of this traffic does not run high, the ends of stock cars will, on the average, receive more severe end shocks than box cars because, with the exception of rails or similar loads of steel, the majority of the materials handled are piled high in the car and some of them, particularly pipe and pulpwood, are slippery, which causes them to produce very heavy shocks, while, on the other hand, box cars being used for a greater variety of lading, do not so frequently have a load of this description.

This condition is not taken care of in many designs, some of which have been recently described in railway papers, and for this reason the accompanying illustrations of the latest type of car built by the Canadian Pacific will be of interest as showing how a very substantial end may be easily and economically applied to car of otherwise standard construction. This car is of a standard design that has given excellent service for some years, except that more recently all the new cars have been constructed with steel center sills in connection with reinforced ends, as illustrated in the drawing, to eliminate draft gear troubles.

The end construction is practically identical with the latest 40-ton steel frame box cars, same consisting of two 5" 11.6 lb. Z bar end posts, heavy angle corner posts, a 5" 11.6 lb. Z bar end plate securely attached to end post, and corner posts securely attached to wooden side plate by means of gussets taking several bolts through the timber. The lower ends of the end posts are connected to the sill plate passing over the top of the wooden end sill and riveted to the steel center sill, thereby securely uniting the center sill construction and end framing. The end lining consists of 2⅜" T. & G. pine or spruce for a distance of 4 feet above flooring, with 1¾" thickness the balance of the height.

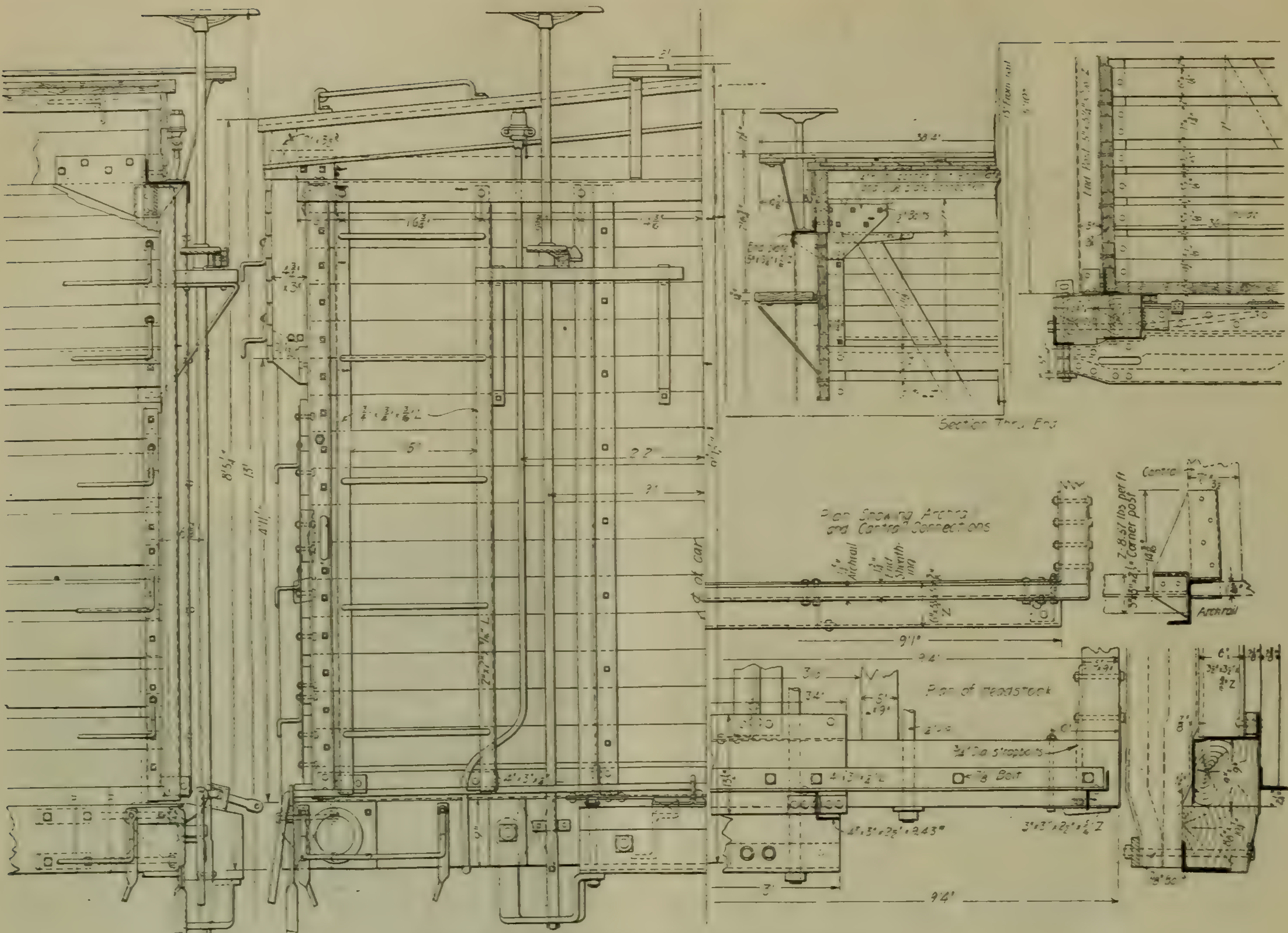
This construction produces a car that is economical in first cost and will satisfactorily withstand usual service conditions either for stock or other service, and if damaged in accident can be easily and cheaply repaired.

The last order of these cars were equipped with socket castings inside of slats to support temporary decks. This temporary deck is so designed that if similar castings are applied, the same deck will be interchangeable in any 36-foot car. When these castings are applied to a car, the sheathing board immediately



Interior of C. P. R. Stock Car.

Thirty-ton Stock Car, Canadian Pacific Ry.



Details of Thirty-ton Stock Car, Canadian Pacific Ry.

below the fascia is removed to provide ventilation for lading carried in upper deck. This alteration does not show in the illustration as the photograph was taken before the board was removed.

STEAM RAILWAY AT THE EXPOSITION.

Of the several means to be taken to eliminate the bugaboo of leg-weariness from the grounds of the Panama-Pacific International Exposition during 1915, the most elaborate and effective will be the little intramural steam railway, with its five miles of steel track. With its eight or ten modern Pacific type engines, 17 feet in length, each weighing 12 tons, equipped with air brakes, standard automatic couplers, and electric headlight, each hauling a train of ten miniature passenger coaches, and running on a regular schedule on a double-track system, the Exposition Marina railway puts the finishing touch to the metropolitan appearance and business facilities of the exposition.

Despite the extremely narrow gauge of the track, only 19 inches, each of the coaches, with a width of 42 inches and a length of 20 feet will contain ten transverse seats, will seat twenty passengers. With ten coaches to each train, and eight trains in operation, sixteen hundred people can be put in motion at once. Conforming to city speed regulations, the trains will make only about ten miles an hour between stations, of which there will be seven, including three terminals, elaborately fitted up with train sheds, elevated platform and turn-tables.

The route, commencing at the terminal at the southeast corner of the Palace of Machinery, near the Panama Canal concession, will be northerly across the plaza of the exposition ferry slips to the water front thence west along the Marina, around three sides of the Yacht Harbor, diagonally across the gardens of the California Building, thence westward between the bay shore and the many state buildings, branching between the live stock yards and the race track. One branch swings around the eastern end of the race course to a terminal at the south entrance to the track grandstand. The other continues along the Marina close to the water front, to a point just west of the Fort Point Life Saving Station, where will be located the main railway yards, engine house and turn tables.

Of the six stations, one will be located on the Marina at the water's edge, just north of the Palace of Mines, a second will be in front of the California building, a third at the intersection of the Avenue of Nations with the Marina, in front of the Colorado and Michigan state buildings, a fourth, which will be very attractive architecturally, between the stadium of the stock exhibits and the grandstand of the race track, and others at the terminals. The main loading station, at the beginning of the line at the Machinery Palace, will be 300 feet in length, with five tracks, between which will be elevated loading platforms, terminating in a turn-table for reversing the baby engines. The entire line, about two and a half miles in length, will be double tracked, with rails weighing 13 pounds to the foot. This railway concession is in the hands of L. M. MacDermott of Oakland, who has worked out to successful completion the many unique problems connected with the installation and operation of the miniature line.

The Chicago, Burlington & Quincy has finished track laying on the extension from Casper, Wyo., to Orin Junction.

Laying of steel is underway at Golden Valley-Dunn Center extension of Northern Pacific. Martin Woldson Co., of Spokane, Wash., has the contract.

Grading has been completed for 14 miles on Glenrose & Walnut Springs and a mile of track laid. J. H. Farr, Walnut Springs, Tex., is interested.

Methods of Handling Boiler Shop Materials, American Locomotive Co.

The Lake Shore & Michigan Southern will build a roundhouse and repair shops at Coalburg, Ohio, in the near future, it is said.

The New York Central & Hudson River has awarded 300 tons of steel for alterations of the Forty-fifth and Forty-sixth street viaducts, New York City, to Levering & Gerrigues.

The New York, New Haven & Hartford has awarded a contract for 550 tons of bridge steel, it is reported.

The Florida railroad has ordered the erection of a union depot by the railroads entering Ocala, Fla., to be completed by June 1, 1915.

The Louisville & Nashville has placed a contract with Rommel Brothers, Louisville, Ky., for roundhouse and repair shops in the yard at Lexington, Ky.

ELECTRIC ARC WELDING.*

By J. H. Bryan, of the Westinghouse Electric & Mfg. Co.

The art of welding, which may be broadly defined as the joining together of metals into intimate and permanent union, dates back to the early days of history. Until within the last half century the only practicable method of making a weld was by a process with which we are familiar, namely, that of heating the pieces to be joined at the point where the union was to be made, then, when they were almost at fusing point, placing them in their proper relation and completing the weld by hammering. This is a comparatively simple operation, and one which is carried out daily in every cross-road blacksmith's shop. There are, however, limitations to the score of this class of work, and until the introduction of the process which we are considering, these limitations were insurmountable. The introduction of the electric arc welding process and the kindred ones of incandescent electric welding and gas welding has, however, very greatly increased the field of possibilities, and we are now able to produce results which were previously impossible to obtain.

The method of joining the metals by the use of the electric arc is one branch of what is known as autogenous welding. This term may be defined as the fusing together of two metals without pressure, by causing them to melt, then mix and unite as they cool. It differs from older methods in that successful results may be produced without hammering or pressure.

Coming now to a consideration of electric arc welding or, more briefly, arc welding as a commercial process, it may be divided into two general classes as follows:

First—Benardos or carbon electrode process in which the arc is drawn between the metal to be welded and a carbon electrode.

Second—Slavianoff or metal electrode process in which the arc is drawn between the metal to be welded and a metal electrode.

These two processes are generally spoken of as carbon electrode and metal electrode welding respectively.

In addition to these there is the Zerener process, in which the arc is drawn between two carbon electrodes, as in an arc lamp, and the metal to be welded is placed in contact with the arc. This is, however, not considered as a commercial proposition in this country at least, as its field of application is limited, and the apparatus itself is unwieldy.

CARBON ELECTRODE PROCESS.

"In carbon electrode welding the metal to be welded is made one terminal of a direct current circuit, the other terminal being a carbon electrode. Upon closing the circuit by bringing the carbon electrode into contact with the metal and then withdrawing it to a distance, an arc is drawn between the two terminals. Through the medium of the arc, which is the hottest flame known (having a temperature between 3,500° and 4,000° Centigrade—6,300° to 7,200° Fahrenheit), the metal may be either entirely melted away, molded into a different shape or fused to another piece of metal as desired.

"In the first attempts to weld by this process the carbon electrode was made the positive side of the circuit and the metal to be welded the negative. Practice, however, shows that it is better to reverse these conditions, for, if not, since the flow of current is from positive to negative, particles of carbon will find their way into the welds, thus tending to make them exceedingly hard and consequently difficult to machine. A further very important advantage is gained by making the metal to be welded the positive terminal. It is a well known fact that in a direct current arc the highest energy consumption—about 75% of the total—and therefore the highest temperature occurs at the positive terminal, and, while no very extended data are available regarding the behavior of arcs having either or both electrodes of metal, there is considerable information regarding arcs and it is fair to assume that, with reference to this particular point, there is not a wide difference between them. Since the positive is at the highest temperature, the greatest amount of heat is at the point to be welded, and therefore where most needed." (*C. B. Auel, American Machinist,* 1911.)

METAL ELECTRODE PROCESS.

The metal electrode process of welding is a somewhat later development than the carbon electrode method, and, as has already been indicated, it differs from the latter in that a metallic electrode is substituted for the carbon.

APPARATUS REQUIRED.

The essential requirements for arc welding are:

First—A suitable source of direct current supply.

Second—A steadying resistance to be placed in series with the arc, together with means for adjusting same, i. e., suitable control equipment.

Third—A means of holding the electrode so that it can be properly manipulated by the operator.

Fourth—Protective covering for operator.

Fifth—Suitable filling material.

Sixth—Miscellaneous material such as flux, fire-clay or carbon blocks for making molds, etc.

DIRECT CURRENT SUPPLY.

Taking up this equipment in order, the direct current supply can be obtained in any one of several different ways. If direct current is available from a shop or commercial circuit, welding can be done directly from this source of supply, but this method has been found to be very wasteful of power and should not be resorted to except where welding is only to be done at very infrequent intervals. An additional disadvantage of the use of the shop circuit as a source lies in the fact that, unless arrangements are made for insulating the work from ground, the shop circuit is grounded, with attendant danger to other employees in the shop, as well as to the welding operators. A much more economical method is that of using a motor generator set, the motor being constructed with characteristics suitable for operation on the shop or other circuit, and used to drive a low voltage generator. In case electric power is not available, the generator may, of course, be driven by belts from a steam or gas engine or from a line shaft.

The generator may be either shunt or compound wound, the shunt wound machine being satisfactory where only one arc is to be operated, while the compound wound machine is preferable if several arcs are to be supplied from the same unit. Experience has shown that generators giving a potential of 75 volts or thereabouts will enable satisfactory results to be produced.

CONTROL APPARATUS.

As different welds require different strengths of current, it is at once evident that there must be some means of regulating the current supply. This is usually effected by inserting resistance in the welding circuit connecting it in series with the arc. Without this resistance, a condition of practical short circuit would occur at the moment the electrode was touched to the work when striking the arc, and, even after the arc is drawn and normal operation begun, the series resistance is necessary for the purpose of steadying the arc, much as is the case in the ordinary arc lamp.

ELECTRODE HOLDERS.

A suitable electrode holder must be provided for both carbon electrode and metal electrode welding. There are a number of forms of these in use at the present time, all of which are arranged with either a spring or a positive clamp for holding the electrode, the construction of the holder being such that the electrode may be removed in a minimum of time. The metal electrode holder differs from that for the carbon electrode in that it is lighter and more compact. The carbon electrode holder has a disc shield on the handle to protect the hand of the operator from the head of the arc, which, when heavy currents are used, would cause discomfort. This shield is not necessary for metal electrode, as the gloves of the operator constitute ample protection.

Protective equipment is necessary for the operator on account of the fact that the exposure to the rays of the arc causes an irritation and subsequent peeling of the skin if the exposure has been sufficiently long, say, several minutes. The irritation is very similar to sunburn and is uncomfortable, but no serious conse-

* A paper delivered before the Western Railway Club, November 17, 1914.

quences ensue, and at the end of a few days all traces of the burn disappear. The clothing has been found to be ample for the protection of the body. For the eyes and face of the operator a hood or shield is provided, both of these being arranged with windows of thick colored glass through which the welding is observed. Experience has shown that, where carbon electrode work is being done, especially when the work is being carried on in an enclosure, the hood is preferable to the shield or mask, as it gives entire protection from reflected light, which is not the case with either of the latter devices. The hands and wrists of the operator should be shielded by gauntleted gloves, which are preferably of leather, although canvas gloves have been found to be satisfactory. The window of the hood or shield should be provided with several pieces of glass in layers, one or more of red and one or more of blue or green, the combination of these colors being much more satisfactory than any one of them used alone.

In addition to the protective covering for the operator himself, arrangements should be made for a suitable enclosure around the work and operator so that the intense brilliancy of the arc will not interfere with other workmen in the vicinity.

FILLING MATERIAL.

When the carbon electrode is used, the filling material is usually of the same metal as that being worked upon and may be used in any convenient form. For instance, when welding steel and iron, filling material may be in the form of rods, clippings from boiler plate, steel chippings, etc. For cast and malleable iron, soft iron rods, punched iron scrap or special cast-iron filler may be used.

These filling materials are fed into the welds and fused into place much as solder is applied with a blow-torch.

When metal electrodes are used for welding iron and steel they should be of best quality of soft iron or steel wire and may range in diameter from ⅛ inch to ¼ inch. The length most generally used is about 12 inches. Copper, bronzes and brasses with a low percentage of zinc may also be welded by this process, in which case the electrodes should be of the same material as that being welded. Where the zinc content of brasses is high, it volatilizes to such an extent as to make the work porous and brittle.

PROCEDURE.

In making a weld by the carbon electrode process, the work is connected to one terminal of the machine, usually the positive, the electrode holder being connected to the opposite terminal. The work, if small, may be laid upon a metallic table which forms the positive terminal. The resistance of the circuit having been adjusted to what is considered the proper value for the work in hand and the circuit breaker and main switch being closed, the operator assumes his position in front of the piece to be welded, taking the electrode holder in one hand and having flux (if same is used) and filling material within easy reach. He finally closes the window of the hood, touches the carbon electrode to the metal to be welded and instantly withdraws it to a distance of 2 inches or more, thus striking the arc. Experience has indicated that with a long arc there is less opportunity for carbon particles to enter the metal and in this way produce a hard weld; the heating effect is also more regular and more evenly distributed. For these reasons the arc should be as long as possible, about 3 inches to 4 inches being the usual length. If the arc is found to be too fierce or to go out due to insufficient current, the resistance in circuit may be increased or decreased accordingly.

After the arc is drawn it is allowed to play upon the work, being given a rotary motion by hand. The object of this motion is to heat a comparatively large area of the surface about the weld so that the consequent cooling will take place more slowly and there will be less danger of cracking the work or of making a hard weld. When the metal flows, the flux (if used) and the filling material should be added a little at a time, the arc, of course, being continued until the metal is thoroughly melted and the weld made. As soon as the metal commences to cool it should be hammered thoroughly in order to prevent sponginess and to give the metal a finer grain. All oxide and other impurities must be kept out of the weld. It is advisable, therefore, to make, if possible, one continuous application of the arc. When, however, more than a single application is necessary, care should be taken to remove all the scale. This may readily be done in most cases by means of a stiff wire brush. Similarly the metal should be cleaned before commencing the weld. To accomplish this, chipping may be resorted to or the piece may be tilted, the arc applied and the impurities allowed to run off by gravity as fast as melted.

The current required for carbon electrode welding varies from a minimum of about 200 amperes to a maximum of around 700 amperes, or even more in very heavy work. In general, however, 300 or 400 amperes have been found to be sufficient for ordinary carbon electrode work.

As is indicated in the foregoing, carbon electrode welding is more or less of a puddling process. A considerable amount of heat is generated, and this is, in many cases, objectionable on account of the expansion of the work, in which strains may be set up on subsequent cooling and shrinking. In work where trouble of this nature is liable to be experienced, pre-heating may often be used to advantage. On small work this may be done by the use of the carbon electrode. The arc is drawn just as in welding, but it is moved about over the piece without being held in any one place long enough to cause fusion. With larger pieces, a temporary furnace may be made by laying fire brick together loosely to form an enclosure around the casting and over it. Heating may be done in any convenient manner either by the use of oil, gas or coal. When the work has reached a red heat, the cover is removed and the welding done without taking the piece from the furnace. After the welding has been completed, the cover is replaced and the work allowed to cool slowly, either with or without a second application of heat.

METAL ELECTRODE PROCESS.

The metal electrode process, though a considerably later development than the carbon electrode method, has a field of application very distinct in many cases from the older process. A principal advantage of its use in work where it is desirable to localize the heat to the greatest extent possible, thus minimizing strains due to expansion and subsequent contraction. An example of this is in the welding of sheet metal or of a broken bridge in a flue sheet. Another advantage of this process is that it enables welding to be done in a vertical plane or even from the underside of the piece to be repaired. This class of work is done daily in railroad shops in repairs to the side sheets and crown sheets of locomotive fireboxes.

The method of using the metal electrode differs from that of the carbon electrode in the fact that a much shorter arc, generally ⅛ inch to ¼ inch in length, is used, and also in that the electrode forms the filling material as it melts and flows into the fused portion of the work.

With the metal electrodes much lower currents are used than in the carbon electrode process. The maximum value hardly ever exceeds 150 to 175 amperes. For a greater portion of the work a current of about 100 to 130 amperes is found satisfactory, although the amount of current required will vary with the size of the electrode and the class of work being done.

CUTTING BY USE OF CARBON ELECTRODES.

The carbon electrode process is also well adapted for cutting of metals. In cutting the arc is drawn just as in welding and is played along the line to be cut, provision being made for the melted metal to run off. Very rapid work of this sort can be done, especially if heavy currents are used. The heat generated varies approximately as the square of the current so that a comparatively small increase in current will give a considerable increase in the rapidity with which work may be done. This process of cutting is used to advantage in work such as cutting off risers and sink heads from castings in a steel foundry, cutting up scrap, and the like, where rapidity and cheapness are of more importance than absolutely smooth finish and accurate work.

APPLICATION.

In spite of the fact that arc welding as a commercial process is of comparatively recent origin, it has been found to have a considerable and ever-widening field of applicability. It has shown

itself to have a distinct range of usefulness, in which it is unsurpassed either by blacksmith welding or by any of the systems of gas welding.

In the repair work of steam railroad shops arc welding equipment has shown itself to be an exceedingly valuable adjunct. The present high standard of maintenance involves constant attention to rolling stock to keep it in first-class condition; reductions in the expenditures for this maintenance have been necessitated by present-day financial conditions in the railroad field. This combination has been an important factor in the introduction of electric welding equipment as a valuable agent in repair work. Among the principal uses of arc welding equipment in steam railroad shops are the following:

Flue welding,
Fire-box repairs,
Frame repairs,
Building up of worn parts.

Besides these there are innumerable minor uses for the equipment.

Flue welding is being done by practically every large railroad shop in the country at the present time, and this welding is, almost without exception, being done by the electric arc process using the metal electrodes. The advantage of welded flues lie in the fact that the results obtained are practically permanent since the flue and sheet are bonded together without a joint. A welded flue in which scale or other troubles do not develop could remain in place indefinitely were it not for the federal limitation of three years. The elimination of leaky flues means not only that road failures due to this cause will be entirely eliminated with attendant delays and expense, but also that maintenance expense on this account is reduced to a minimum. In this connection, I would like to quote from the proceedings of the International Railway General Foremen's Association, the quotation in question being a part of the report of the committee on autogenous welding and covering the experience of one road (the Central of Georgia):

"A field in which electric welding has proved very successful and profitable is that of welding flues to back flue sheets. We have in service today over ninety locomotives with flues welded to back flue sheets, making a total of about 27,000 flues. Out of this number of locomotives in service with flues welded, we have our first engine to fail on line of road with flues. We have, therefore, had some few flues to leak after being in service a short time, but this was due to bad beads on flues when welded in. If part of the bead is off, exposing the copper (ferrule) it is very difficult to get a good weld.

"Our first experience on flue welding was tried out on a Pacific type engine. This engine was shopped for a new back flue sheet. The old sheet was so badly worn and buckled that it was impossible to keep flues tight. We had just installed our electric welding plant and we were anxious to see what could be done along this line. Flue heads and sheets were thoroughly cleaned with sand blast, given a light working and welded in. The engine was put back into service June 1, 1913, and to date (July, 1914) has given no trouble by leaking. During this time hydrostatic test was applied and no leaks developed. This job was done at a cost of $14.68, where a new flue sheet would cost about $150 and the engine held out of service at least 30 days."

This report was made by one of the members of the association, and serves to indicate some of the work that is being done along these lines.

General practice varies as regards the best method of welding flues. In most cases, however, the flues are applied in the usual manner with copper ferrules and rolled, beaded and pressed. The head is then welded to the flue sheet, leaving a fairly rough finish which has not been found to be objectionable. The time of welding flues will probably average 15 per hour, although as high as 25 per hour have been reported. This time is for 2-inch flues. Five-inch superheater flues are being welded at about one-fourth this rate.

It is interesting to note that the flue sheet is found to be in better condition upon removal of flues than is the case where flues have not been previously welded in. This is due to the fact that the welding builds up the sheet around the flue holes to about the original thickness. Where welded flues are to be removed it only requires a few hours longer to cut down the beads, and by the use of a special tool for facing off the rough surface after the flues are removed a good clean sheet is left.

Flue welding has not been entirely satisfactory in every case, but it is believed that the difficulties which have been experienced have been due to methods used and not to the process itself, and these difficulties seem to be diminishing with the increasing experience which is being obtained on this class of work.

FIRE-BOX REPAIRS.

Closely related to flue welding is the subject of fire-box repairs. The defects to be repaired include cracks in the side, flue, door and crown sheets, leaky stay-bolts, leaky seams, etc. Also sheets will often be found to be in such condition that repairs are impossible, and it is necessary to put in patches. All of this class of work can be done very satisfactorily by the use of the arc welding equipment. In the case of cracks, etc., it is necessary that the sheet be cut along the crack into a notch, or "V" shape, so as to enable the weld to extend through the whole thickness of the sheet. The "V" is cut either by the use of the carbon electrode, or preferably by a chisel. It is then filled in, using the metal electrode and a slight reinforcement built over the outside of the weld.

Where a sheet has gotten into such shape that it is necessary to replace it, it may be cut out by the use of the carbon electrode and a new section welded in. Half side sheets, door sheets, etc., are being welded in without difficulty.

In this connection the repairing of mud rings might also be mentioned. A mud ring is often found to be badly corroded at the corners of the fire-box, due to bad water. Where this is found to be the case, the sheet can in many cases be cut out at the corners of the fire-box, thus giving access to the corroded portions of the mud ring which may be then built up. The section of the sheet that has been cut out is then put back and welded into place. The same method may often be used in the repair of a cracked mud ring.

Broken locomotive frames are very satisfactorily repaired by the use of the electric arc. The frame is prepared by notching either from one side or from both sides, preferably the latter; the notch is then filled in by the use of the metal electrode. A reinforcement is also built up around the frame at the place where the weld is made, so as to give extra strength at this point. The electric arc process of welding is probably cheaper than any other for this class of work and is found to be just as permanent as can be obtained by any other means. An additional advantage of its use lies in the expedition with which the work may be completed, as no dismantling of the locomotive is necessary beyond that required to allow the welder to secure access to the broken parts. Cases have been known where a frame has been welded without drawing the fire. One railroad (R., F. & P. R. R.) reports that it has in service at the present time 65 welded locomotive frames and has had only one failure. This failure was attributed to the fact that the arc weld was in close proximity to one made by another process. In work of this sort it is often found desirable to pre-heat the member of the frame opposite the one which is being welded in order to insure the absence of strains upon cooling.

Tender tank repairs can also be easily made, the methods used being similar to those applied to boiler work.

SAVINGS EFFECTED BY ARC WELDING IN RAILROAD SHOPS.

The following figures were taken from records of actual repairs made in a large railroad shop in the middle West at various times, the figures given being a comparison between the actual cost of welding and that of putting the apparatus back into service by methods previously used, either by replacement or by repair of the old parts. The arc welding costs were based on a power cost of 51 cents per hour for the carbon electrode and 17 cents per hour for the metal electrode, together with cost of labor and an overhead charge of 40%. It might be mentioned in passing that the power

costs used are slightly higher than those usually obtaining in shops of this nature:

	Cost of welding.	Cost by other methods.
Plugging 51 holes in expansion plate, holes 1 inch dia. by ½ inch deep	$ 2.75	$ 10.15
Repairing mud ring	6.50	34.57
Cutting four 6-inch holes in tender deck sheet ½ inch thick	1.08	8.35
Welding eccentric strap, broken through neck	1.08	41.28
Repairing mud rings	6.50	24.57
Welding two spokes in driving wheel center	7.98	99.98
Welding cracks in bulkhead in tender tank	2.33	8.00
Welding cracks in side sheets	26.15	31.79
Repairing fire-box	134.89	869.58
Building up flat spots on locomotive driver	.40	225.00

Numerous other figures could be presented showing similar savings.

With reference to the last item given above, namely, that of building up flat spots on locomotive drivers, the repair in this case is effected by welding at the roundhouse without withdrawing the locomotive from service. The tire is simply built up at the flat spot and filed to shape, using a templet. Against this the cost of repair by other methods would include the sending of the locomotive to the shop and having the entire set of drivers turned down, which usually means putting the locomotive out of service for at least a week or ten days, as well as the loss of at least one year's wear on the tires. Taking the loss of revenue from the idle engine, the cost of the older method might easily be $500 or more.

ELECTRIC RAILWAYS.

Electric railways have found an instrument of great value in electric arc welding. In addition to the use of this process in their shops for repairs to their rolling equipment, they are using arc welding for a wide variety of track work, such as rail bonding, frog and switch repairs, low joints, etc.

The shop repairs made by electric railways range from the filling of a worn dowel hole in a bearing cap to the reconstruction of a railway motor. Sheet metal gear cases which have holes worn in them are easily repaired by placing a new sheet over the hole and welding around the edges. Dowel holes which are worn may be filled with solid metal and then drilled and reamed to the proper size. Armature shafts with worn keyways or worn tapers are built up and remachined to proper size. Worn journals may also be built up and returned so as to fit standard bearings. Parts of trucks which have been worn by long service can be brought back to original dimensions. In fact, the electric railway shop offers almost as wide a range of applicability for this process as does that of the steam railroad.

A number of electric roads all over the country are using the arc welding process as a means of making track repairs and also in new construction and rebuilding of lines. Welding of rail joints is being very extensively done. The method of making a joint by this process consists of using a strap or plate which is put across the joint just as is the ordinary splice-bar, except that the joint is not made up complete by bolting, as is the case with the other methods. The plate may be clamped to place or may be held by one bolt through the end of each rail. The welding is done by the use of the metal electrode which is applied to the top and bottom edges and the ends of the plates. The advantages of this method of making joints lie in the fact that a permanent joint is secured, that no additional bonding is required, and last, but not least, that the cost of making up a joint complete by this method is considerably less than by other methods of making welded joints.

A source of considerable expense on roads where traffic is heavy lies in cross-overs and frogs. These wear rapidly under the pounding of traffic and will need frequent repair or renewal. These repairs can be made speedily and cheaply by the use of the arc and the results obtained will be almost as permanent as in the case with the original material.

The repair of low joints and "cupped" rails needs no comment beyond the statement that the methods used are exactly the same as those used on frogs and switches, namely, building up to a proper height by use of the metal electrode and bringing to finished surface by grinding.

WELDING FROM 600 VOLTS.

A large number of electric railways are at the present time doing welding from the trolley circuit, using resistance in series with the arc to hold the current at the required value. Satisfactory work can be done by this method, but it has two very important disadvantages; one of these being that it is extremely wasteful of power, and the other, that the danger to the welding operator is very considerable, on account of the fact that one side of the welding circuit is grounded and the operator is in constant danger of serious or fatal injury from shock.

Taking the first of these objections, the difference in power required can be easily seen by considering a concrete case. If for a given operation the current required is 200 amperes, the total power used will be in the case of the 75-volt motor generator set 200 times 75, which equals 15 KW. In case the current is taken from a 600-volt circuit, the power required will be 200 times 600 equals 120 kilowatts. Assuming that this amount of power is required for 50% of the total time, the kilowatt hours per operator per ten-hour day would be in the one case 15×5, or 75 KWH. And in the second case 120×5, or 600 KWH. Where the motor generator is used there will be, of course, a certain amount of additional power required to supply the no-load losses of the set when running light. Assuming these to be for the day 25 KWH, the total amount of power used in the first case would be 100 KWH, the difference being 500 KWH in favor of the low voltage equipment. At 1 cent per KWH the difference would be $5 per day, or on 300 days per year $1,500 saved by the use of the motor generator set.

The foregoing figures are, of course, very approximate, but even if the power cost should be only one-half cent or one-half as great as shown, the saving would still be in the neighborhood of $750, so it would appear that the purchase of the low voltage motor generator and equipment would be justified, as the first cost of such an equipment for one operator would only be around $1,100 or $1,200.

MARINE REPAIR WORK.

An industry of comparatively recent origin is that of the repair of marine boilers. Practically every large harbor now contains one or more repair barges. These barges are equipped with an arc welding equipment and a compressor for furnishing air for sand blast and pneumatic tools; they are employed in the repair of the boiler equipment of vessels that may arrive in the harbor in need of such repairs. The barge is brought alongside the vessel while the latter lies at the dock; cables and air hose are carried through convenient port holes to the point where work is to be done, thus enabling the necessary repair work to be accomplished without any loss of time on the part of the steamer.

GENERAL REPAIR WORK.

There are a number of minor applications of arc welding equipment, among which may be classed general repair work in large shops, work in steel plants, cutting up scrap, etc.

Industrial plants employing a large number of machines will oftentimes be able to reduce their maintenance expense very considerably by the use of arc welding equipment. Repairs to be taken care of in these shops consist of broken shafts, worn journals and keyways, broken gear-teeth, worn rolls, etc., etc. The welding equipment may be installed permanently and wiring carried to different sections of the shop where welding is likely to be required, or the repair equipment may be made portable and suitable connections arranged for the motor end of the equipment. Still another method is that of installing the motor generator and wiring permanently, and using a portable welding control panel which is connected to the circuit by plugging in at the point where work is to be done.

Mention has already been made of the cutting off of risers on

heavy castings in steel foundries. This work is done by the use of the carbon electrode with heavy currents. Risers may be cut off very rapidly and without removing them from the sand if desired. This method is far cheaper in the case of large castings than the use of oxyacetylene or the cold saw.

In steel mills still another point where the welding equipment is of value will be found. It occasionally occurs that the tap holes or tuyeres of blast furnaces will become plugged with cinder or cold metal. Without the use of the electric arc, this would necessitate in many cases the loss of the heat and the closing down of the furnace to allow the chipping out of the slag or metal by hand, which is a very slow and tedious process. By the use of the carbon electrode, however, the obstruction may be cut away so rapidly that in most cases operation of the furnace need not be suspended. The carbon electrode is used and heavy currents, around 750 to 1,000 amperes, may be employed. Where the obstruction consists mainly of metal, it is only necessary that one terminal be connected to the furnace so that a path of reasonably low conductivity to the obstruction is secured. Where, however, cinder is present in such quantities as to make the obstruction of high resistance, it may be necessary to drive an iron bar through the cinder in order to obtain satisfactory results, the bar being burned away and with it the cinder. With currents as indicated above, the hole may be opened at a rate of about 30 inches per hour.

MANUFACTURING.

The arc welding process has been found by experince to be very well adapted to certain classes of commercial manufacturing operations, replacing smith welding and showing very great savings. An example of this may be seen in the case of a large electrical manufacturing company. Here certain lines of motors and generators are constructed almost entirely of steel; the yoke or frame ring is made by rolling a slab of open hearth steel around a mandrel. This, of course, leaves a gap which must be closed, and the carbon electrode process is used for this work. An indication of the saving in cost on this class of work will be shown later. As to the quality of the work, it is found to be fully equal to that produced by fire welds, both from the standpoint of a homogeneous weld and from that of ease of subsquent machining. Similar applications can be found in very many metal working plants.

It is not to be inferred from this that arc welding is a manufacturing operation primarily, as such is not the case. Its greatest field of usefulness lies in repair work, as distinguished from incandescent welding, which is not at all suited to anything except repetition work, as in manufacturing quantities of duplicate pieces.

INSTALLATIONS.

The earlier installations of arc welding equipment employed a motor generator for each operator, but this method was soon found to have several disadvantages in shops where two or more operators were to be employed. In the first place electric arc welding is essentially an intermittent process, and experience has shown that the arc will be in actual use not more than 50% of the total time in most cases. From this it can be seen that the load factor of the motor generator would be below and that the cost of power would be correspondingly higher. In the second place, such an installation is necessarily more expensive than one employing a motor generator of sufficient capacity to supply all operators within a reasonable range, and it would also be more expensive as far as regards maintenance. Again, the efficiency of the smaller equipment will necessarily be lower than that of the large unit. The general practice now allowed is that of installing a motor generator of sufficient capacity to supply all operators within a range of 500 to 600 feet of the set, permanent wiring being installed and panel outlet for the individual operators located at points where it is desired to do welding.

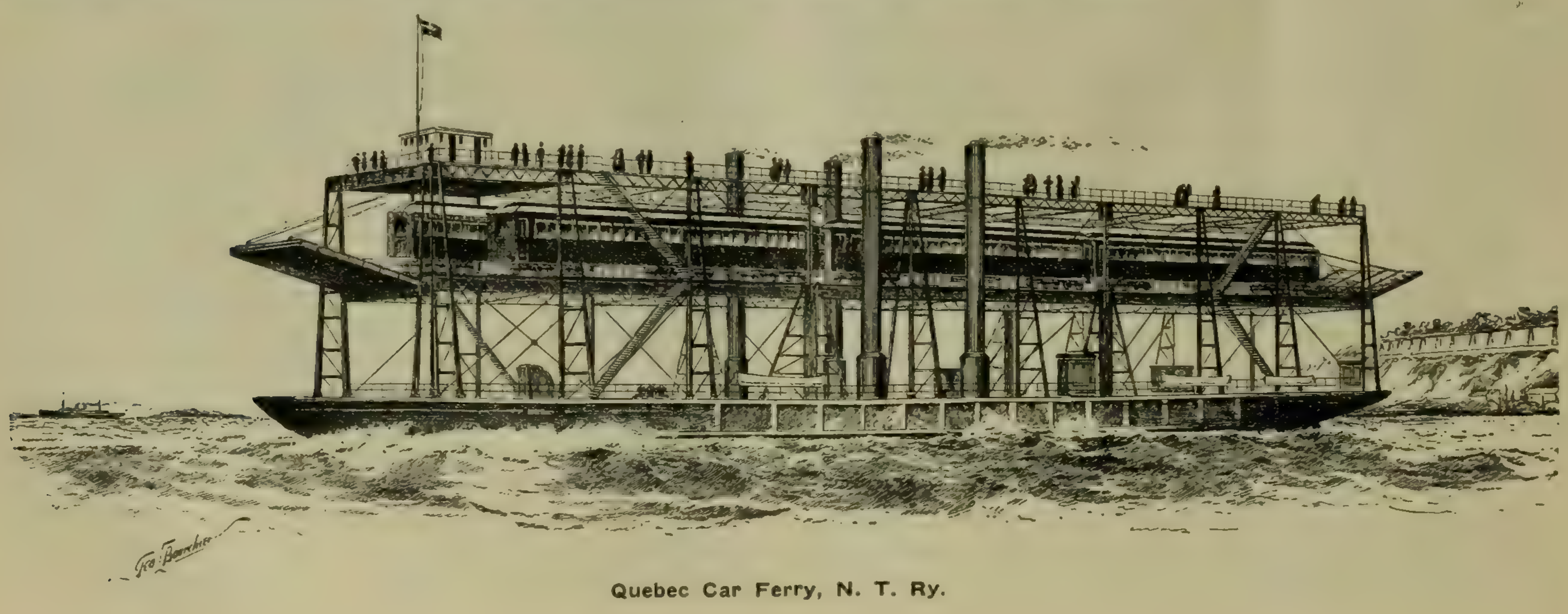
A word as to the size of outfit required may not be amiss.

No hard and fast rules can be laid down, as no two installations will be alike in their requirements, and the matter of selection of apparatus of proper capacity is largely one of judgment and experience. It may be said, however, that in general for miscellaneous repair work around large industrial plants a 300-ampere equipment, which is of sufficient capacity to take care of two operators on metal electrode work, or to do, where necessary, light carbon electrode work, is usually satisfactory. For electric railways for track work, a 200 or 300-ampere outfit will be found to be about the proper size. In the repair shop, the track repair outfit may be used or a separate outfit may be installed if conditions justify it.

In steam railroad shops installations are usually made of sufficient capacity to take care of not less than four to six operators, and the larger shops can occasionally use even greater capacities to advantage. Where a greater number of operators are to be supplied, however, it is generally found to be more economical to install additional outfits in other sections of the shop where welding is to be done, rather than to put in one large central plant. This is on account of the fact that as this work is usually more or less scattered the cost of line copper becomes an item for consideration.

In steel foundries and steel mills, outfits of 800 to 1,000 amperes capacity are usually installed. These are large enough to take care of six or eight operators on metal electrode work respectively, but most of the operations found in these industries will be performed with the carbon electrode, and the large capacity will be found advantageous in that it will enable more than one operator to be employed using the carbon electrode, or, when necessary, the full capacity of the machine can be concentrated at a single arc, thus enabling extremely rapid work to be done.

In conclusion, it should be noted that arc welding is not to be considered as a panacea for all the ills that the metal worker is heir to. There are many classes of work for which it is entirely unsuitable, but its range of usefulness is so wide that it has long since fully justified its existence.



Quebec Car Ferry, N. T. Ry.

CAR FERRY, N. T. RY.

By George S. Hodgins,

(Formerly Consl. Mech. Engr., N. T. Ry. Comm.)

It may seem somewhat strange that the effect of ocean tides should have to be considered by a land transportation company like a railway, but the National Transcontinental Railway car ferry at Quebec is a case in point. This railway has been built by the Canadian Government from Moncton, N. B., on the Intercolonial Railway to the city of Winnipeg. It will very shortly be turned over to the Grand Trunk Pacific to operate, while the government will receive a specified rental for fifty years, after which the operating rights revert to the government.

The car ferry plies between Quebec and Point Levis, and has been built to specification by Cammell, Laird & Co., of Birkenhead, England. This flat bottomed boat is of steel, 362 ft. long and 65 ft. beam. It has a draught of about 15 ft. and is, in fact, a twin screw steamer, the propellers of which are driven by two sets of triple expansion condensing engines, supplied with steam from eight large marine boilers, working under natural draught. The vessel has been built to Lloyd's special survey and is arranged for the carriage of passenger and freight trains across the St. Lawrence river at all seasons of the year.

The striking feature of the ferry is the arrangement of three car tracks, each 272 ft. long, placed upon what has been called the tide deck. This deck is a movable structure above the main deck. It is in fact a huge table supported on columns like the elevated railways of Chicago and New York. On each side this enormous table has ten supporting columns, or twenty in all. The columns are stayed by lateral bracing to provide for longitudinal and transverse thrusts. These columns terminate in lifting screws which are hung on ball bearings from above.

The lifting of the tide table or train deck is effected by machinery of special construction. The engine is of the four-cylinder high pressure type, driving a double helical spur gear, which in turn gives motion to a second shaft placed athwartship. At each end of this shaft is a pair of mitre wheels driving the fore and aft main line shafting on the port and starboard sides of the vessel. At equal distances along this shaft are arranged worm and wheel gearing for turning the lifting screws. The worms are of forged steel and the wheels are cast iron. The screws are driven through a loose forged steel sleeve with sliding key fitted into the box of the wheel. The screws are fitted with heavy gun metal nuts screwed with buttressed threads, and these nuts are supported from the upper structure by ball bearings of special design.

The fluctuations of the tide at Quebec are such that this table can be raised or lowered through a distance of 18 ft. and the engines are capable of pushing up the table loaded with a train of nine cars or a maximum weight of 1,440 tons or 2,880,000 pounds, at a speed of one foot a minute. The table has at each end adjustable landing gangways which are hinged on the ends of the tide table and which are raised or lowered at their free ends by electrically driven machinery. It is thus possible to place the ferry at the Quebec side and take a train across, and some hours later, when the level of the water has risen or gone down, by the action of the tide, to readjust the train table and so preserve the loading level at practically the same height with reference to the shore approaches.

Not only has the ebb and flow of the tide to be taken into consideration, but the vessel is expected to operate in the winter when the severe cold of Quebec causes a substantial ice bridge to form over the river. In order to enable the vessel to cut its way through the ice, a propeller wheel is placed on the water line at the bow. The propeller is driven by a separate engine of the compound, surface condensing type. The cylinders are 15x32x21 inch stroke. The propeller is made of nickel steel, and is of course not used in the summer.

While fully loaded the ferry is capable of making 15 miles an hour, and it is calculated that it will make the 2½ miles across the river in three-quarters of an hour. This time includes time for adjusting the train deck and running the cars on and off. The boat carries 250 tons of coal, 65 tons of fresh water and stores. All the auxiliary pumps are independent of the main engines.

The vessel is fitted with electric light throughout and electric gear is provided for lifting and lowering the end gangways and for hauling the cars on and off. Special arrangements are made for heating the coaches during the trip. Double windlasses are provided, one on each side, with slip drums for mooring. Above the highest position of the train table a raised gallery runs round it, with a bridge and wheel house, from which the operations of steering and maneuvering are directed. A crew of fourteen men will handle the ferry, and it will travel over the waters where General Wolfe's men passed on their memorable assault on the city on September 12, 1759.

The Railway President Is Interrogated by the Politicians As to What Reasons, If Any, He Has for Continued Existence.—(Exchange.)

New Books

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION. Proceedings of the sixth annual convention. Paper, 6x9 inches, 145 pages, illustrated. Published by the secretary, Owen D. Kinsey, 7223 Ridgland Ave., Chicago.

This volume reflects especial credit on the association and its secretary. The matter is well arranged, the illustrations are clear and readable, and the whole is a very attractive book. It contains a complete report of the meetings of the association held at Chicago on July 20, 21 and 22, 1914. Among the subjects contained are "Standardization of Reamers," "Tool Room Grinding," "Safety Applied to Grinding Wheels," "Machine Tool Repairing," "Distribution and Delivery of Shop Tools," "Special Tools for Drilling, Reaming and Milling," "Special Dies for Cold Work." This association has a live membership and its proceedings contain matter of interest to every tool foreman and shop man.

MASTER BLACKSMITHS' ASSOCIATION. Proceedings of the twenty-second annual convention. Cloth, 6x9 inches, 298 pages, illustrated. Published by the secretary, A. L. Woodworth, Lima, O.

The annual meeting of this association for 1914 was held at Milwaukee on August 18, 19 and 20, and this volume contains the paper and addresses delivered before the meetings, together with the discussions. The subjects discussed are as follows: "Carbon and High-Speed Steel," "Tools and Formers," "Electric Welding," "Drop Forgings," "Spring Making and Repairing," "Piece Work," "Frame Making and Repairing," "The Oxy-acetylene Process," "Case Hardening," "Heat Treatment of Metals." The proceedings are in the usual form, which has been standard with the association for a number of years.

Personals

H. B. Hayes succeeds J. A. Cassady as master mechanic of the *Alabama Great Southern.* His office is at Birmingham, Ala.

Frank K. Moses has been appointed master mechanic of the *Baltimore & Ohio Chicago Terminal,* with headquarters at East Chicago, Ind. He succeeds J. W. Fogg, resigned.

E. J. Langhurst has been promoted to road foreman of engines of the *Baltimore & Ohio,* with office at Parkersburg, W. Va.

J. Shiver succeeds E. J. Langhurst as assistant road foreman of engines of the *Baltimore & Ohio,* with office at New Castle, Pa.

E. S. Foster succeeds A. L. Moler as traveling engineer of the *Bangor & Aroostock,* with office at Derby, Me.

H. F. Staley has been appointed master mechanic of the *Boyne, Gaylord & Alpena,* with office at Boyne City, Mich. Mr. Staley was formerly master mechanic of the *Carolina, Clinchfield & Ohio.*

A. Sturrock has been appointed master mechanic of the *Canadian Pacific* at Nelson, B. C., succeeding A. Mallinson.

J. A. Moore, car foreman of the *Canadian Pacific,* has been transferred from White River, Ont., to Muskoka, Ont., vice E. E. Potter, on leave of absence.

John Flynn succeeds J. A. Moore as car foreman of the *Canadian Pacific* at White River, Ont.

W. H. Wortman succeeds A. Sturrock as general foreman of the Ogden shops of the *Canadian Pacific* at Calgary, Alta.

D. D. Cossar, locomotive foreman of the *Canadian Pacific,* has been transferred from Moose Jaw, Sask., to Winnipeg, Man.

T. S. Bertram, locomotive foreman of the *Canadian Pacific,* has been transferred from Revelstoke, B. C., to Moose Jaw, Sask., succeeding D. D. Cossar.

W. Gillespie has been appointed mechanical superintendent of the *Central Vermont,* in charge of motive power and car departments, reporting to the president. The offices of master car builder, superintendent of motive power and master mechanic have been abolished.

W. F. Weigman has been appointed general foreman car department of the *Charlestown & Western Carolina,* with offices at Augusta, Ga.

J. W. Brewer has been appointed foreman of locomotive repairs of the *Chicago & Alton,* at Glenn, Ill.

W. A. Housan has been appointed general foreman of the *Chicago & Eastern Illinois,* at Mitchell, Ill., vice T. E. Hendricks.

O. D. Fuller succeeds H. B. Forsberg as shop foreman of the *Chicago & North Western,* at Superior, Neb.

W. Smith succeeds C. W. Owens as shop foreman of the *Chicago & North Western,* at Deadwood, S. D.

E. Wanamaker has been appointed electrical engineer of the *Chicago, Rock Island & Pacific,* succeeding F. J. Glover, resigned. He will have charge of engine and car electric lighting and the inspection of electrical appliances in shop, roundhouses, power houses, etc., with headquarters at Chicago, Ill.

D. W. Higgins succeeds W. D. Oakford as road foreman of engines of the *Chicago, Rock Island & Pacific,* at Fairbury, Neb.

H. E. McElrath succeeds J. H. Wood as road foreman of engines of the *Chicago, Rock Island & Pacific,* at Eldon, Mo.

J. A. Cassady succeeds H. B. Hayes as master mechanic of the *Cincinnati, New Orleans & Texas Pacific* at the Ferguson shops

R. E. Molt succeeds T. J. Precious as locomotive foreman of the *Great Northern* at Gold Bar, Wash.

A. Zendritza succeeds J. Goldstrand as car foreman of the *Great Northern* at Fargo, N. D.

W. D. Bennett has been appointed master mechanic of the *Kansas City, Mexico & Orient of Texas,* with headquarters at San Angelo, Tex., vice G. W. Tamsitt, resigned.

William Gemlo, master mechanic of the *Minneapolis & St. Louis,* has been transferred from Marshalltown, Ia., to Minneapolis.

C. W. Warcup has been appointed master mechanic of the *Minneapolis & St. Louis* at Marshalltown, Ia.

H. H. Harris succeeds G. Moser as machine shop foreman of the *Minneapolis & St. Louis,* at Minneapolis, Minn.

J. D. Reynolds succeeds G. Mitchell as machine shop foreman of the *Minneapolis & St. Louis* at Marshalltown, Ia.

P. Wikle succeeds H. F. Leonhardt as paint shop foreman of the *Minneapolis & St. Louis* at Marshalltown, Ia.

W. Jans succeeds B. R. Gillett as roundhouse foreman of the *Minneapolis & St. Louis* at Winthrop, Minn.

A. H. McDonald succeeds J. H. Henley as road foreman of engines of the *Missouri, Kansas & Texas* at Muskogee, Okla.

H. C. Oviatt has been appointed assistant mechanical superintendent of the *New York, New Haven & Hartford,* with office at New Haven, Conn. He will have charge of the new bureau of fuel economy.

H. Selfridge succeeds H. A. Gillies as general shop foreman of the *Oregon Short Line* at Salt Lake City, Utah.

W. C. Burel succeeds H. Selfridge as foreman of the *Oregon Short Line* at Montpelier, Ida.

V. E. McCarty, traveling engineer of the *Oregon Short Line,* has been transferred from Nampa, Ida., to Pocatello, Ida.

G. H. Watkins succeeds F. G. Grimshaw as assistant engineer of motive power of the *Pennsylvania,* with office at Pittsburgh, Pa.

Joseph Slutzker succeeds G. H. Watkins as assistant master mechanic of the *Pennsylvania* at Pittsburgh, Pa.

Ivy L. Lee, executive assistant of the *Pennsylvania,* has resigned to become a member of the personal staff of John D. Rockefeller, New York.

I. A. Seiders has been appointed fuel inspector of the *Philadelphia & Reading,* with office at Reading, Pa. Mr. Seiders was formerly road foreman of engines.

John Scheifele succeeds I. A. Seiders as road foreman of engines of the *Philadelphia & Reading* at Reading, Pa.

John O. Boyer has been appointed road foreman of engines of the *Philadelphia & Reading* at St. Clair, Pa.

F. L. Carson has been appointed acting superintendent of motive power of the *San Antonio & Aransas Pass,* with office at San Antonio, Tex.

E. H. McCann succeeds J. H. Ruxton as superintendent of motive power of the *San Antonio, Uvalde & Gulf,* with headquarters at Pleasanton, Tex.

A. P. Neff has been appointed general foreman, locomotive shop, of the *Southern Pacific* at Los Angeles, Cal. He succeeds G. H. Goodwin.

F. E. Cavender succeeds D. F. Knapp as master car repairer of the *Southern Pacific* at Portland, Ore.

J. Sturm, master car repairer of the *Southern Pacific,* has been transferred from Stockton, Cal., to Roseville, Cal.

W. R. Parker succeeds J. Sturm as master car repairer of the *Southern Pacific* at Stockton, Cal.

S. S. Stiffey has resigned as superintendent of motive power of the *Toledo & Ohio Central* and the office has been abolished. C. Bowersox, master mechanic, will assume the duties of the office, with headquarters at Bucyrus, O.

T. McClymont has been appointed foreman boiler maker of the *Toronto, Hamilton & Buffalo* at Hamilton, Ont., vice F. Fell.

OBITUARY.

James Bissett, formerly master mechanic of the *St. Louis & San Francisco* at Springfield, Mo., died on November 4 at the age of 50 years.

Among The Manufacturers

LOCOMOTIVE DISTRIBUTION BOX.

The rapid increase in the number of electric headlights in use on locomotives has brought up a number of questions in connection with wiring the locomotive, and many different methods are in use. With the shopping of a locomotive and the consequent removal of the cab, it is in many cases necessary to disturb the wiring and in fact to entirely rewire the engine.

In order to do away with difficulties of this sort and to save wire and fitting, the Central Electric Co. of Chicago has designed and placed on the market a distributing box which is placed on the front end of the cab. The wires from the cab terminate in this box, as does also the conduit from the head end.

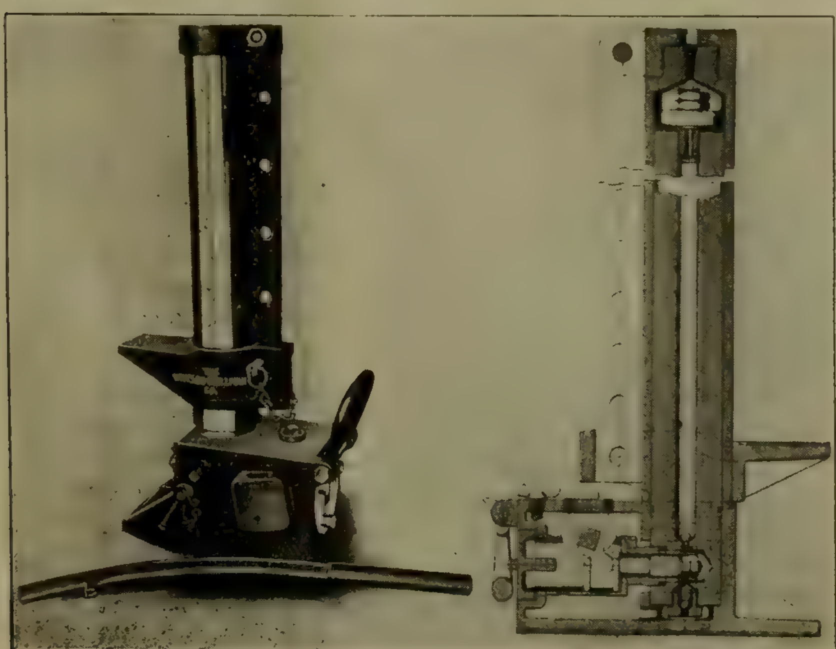
Locomotive Distribution Box.

To remove the cab it is only necessary to remove the cover of the distributing box and disconnect the wires from the terminal block. When the cab is replaced the operation is of course reversed. With the use of this box neither the wiring in the cab or in the locomotive is disturbed.

EMERGENCY HYDRAULIC JACK.

The Watson-Stillman Co., New York, has just brought out a new type of hydraulic jack that embodies original features in hydraulic jack construction. Primarily the design was intended to cover the demands of an emergency jack for street railway use, but it has proved adaptable for any shop or factory where lifting work is occasionally or constantly performed. By referring to the illustration the following features will be noted:

The claw can be moved vertically and adjusted to the most convenient height and can, with the cylinder, be swung in a complete circle without changing the position of jack or of the pump level. The cylinder is the moving part of the jack instead of the ram, thus allowing the pump mechanism to stay in a fixed vertical position which permits the working parts to be made simple and more compact than is usually the case. The piston is packed with leather rings, the valves are of the ball type and all passages are made amply large with the result that the construction is practically fool proof.



Emergency Hydraulic Jack. Sectional View at Right.

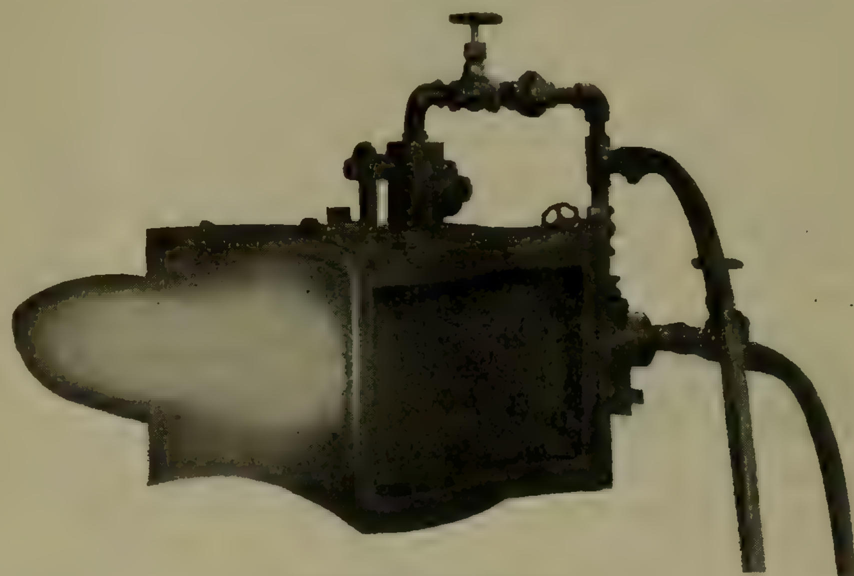
This jack is operated with a special oil, which as well as acting as a lubricant prevents rust on working parts, the possibility of freezing, and has no detrimental effect on the packings. The releasing of the pressure is by a key operating a small needle valve.

While the operating lever is but 18 inches long, one man weighing 125 pounds can obtain the maximum pressure with but slight effort. The lever is made curved in shape and the socket has a hole in each of its four sides to allow convenience in operation from practically any position.

These jacks are now built in 5 and 10 ton sizes with a ram stroke of 10 inches, and are guaranteed to stand a 50 per cent overload without detrimental effect to any of their parts.

MONARCH TIRE HEATER.

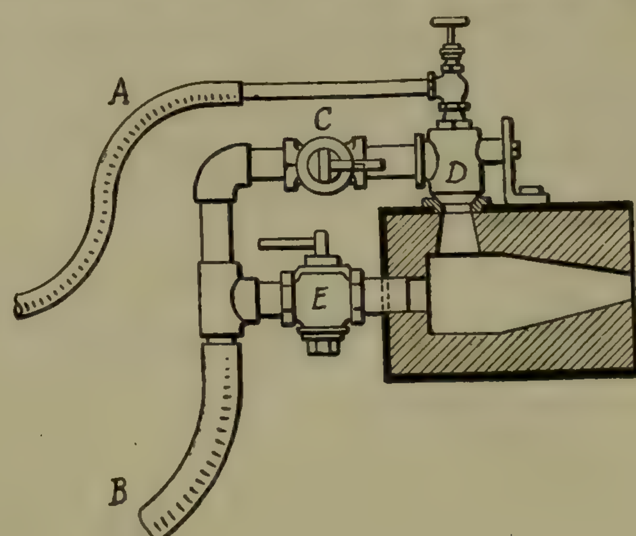
The type of tire heater and expander shown in the illustration is adjustable to any size tire, as six or eight units are used according to the diameter of the wheel, thus making them adjustable to a tire of any diameter from 2½ to 10 feet. The heater is



Monarch Tire Heater.

heavily reinforced and the flame is surrounded with the necessary fire clay muffle. The distribution of the heat is uniform and is so arranged that it is not hard on the men doing the work.

The oil or gas is conducted through the metallic flexible hose "A," the air (see sketch), which is low pressure (not over 16 ozs.) is conducted through the hose "B." The cock "C" admits air into the mixer "D," which atomizes the oil; finally



Section of Monarch Tire Heater.

the cock "E" admits sufficient air to make the combustion complete.

These heaters use any kind of oil and have recently been placed on the market by the Monarch Engineering & Mfg. Co., of Baltimore, Md.

SAFETY LATHE DOG.

A lathe dog which combines the convenience and efficiency of the common lathe dog with a perfect shield for the set screw head has been brought out by Armstrong Bros. Tool Co., Chicago.

The objectionable special wrench is eliminated and the extra leverage provided by the safety cap makes the adjustment of the set screw by hand easy and fast. The construction of the dog is easily understood by reference to the illustration.

Safety Lathe Dog.

The interior of safety cap is shaped to conform to the head of the set screw, so that when the cap is turned the set screw turns with it, the head of screw slipping up or down inside the safety cap.

New Literature

The Independent Pneumatic Tool Co., of Chicago, has issued circular E-2 descriptive of "Thor" portable electric drills.

* * *

Bulletin 34-S of the Chicago Pneumatic Tool Co., Chicago, is devoted to small power driven compressors. These compressors supplement the line of over four hundred sizes and types now made by the company.

* * *

J. S. McChesney & Co., Chicago, has issued a bulletin descriptive of the Kreutzberg air meter. Among other uses it has been found quite valuable for use in shops. On account of its light and simple construction it can be cut into any pipe line, thereby detecting any leakage of air.

* * *

The Neil & Smith Electric Tool Co., Cincinnati, O., has recently issued a catalogue of its portable electrically driven tools, which includes a number of new adaptations. Among these is a portable electric center grinder, an electric screw driver and direct connected electric saws.

The Selling Side

The Plastic Railroad Tie Co., 437 N. Main street, Tulsa, Okla., is now establishing a plant at Corning, N. Y., for the manufacture of concrete ties.

Ellsworth Haring has terminated his connection with Hermann, Boker & Co. and has organized a business in tool steel and related specialties, with offices at 684a Hancock street, Brooklyn, N. Y.

The Pennsylvania Tank Car Co., the Petroleum Iron Works Co. and Pressed Steel Products Co. have been incorporated in Ohio by C. H. Todd, G. P. Bard, J. L. Considine, J. P. Sweeney and G. C. Mittinger.

The Power Specialty Company, of New York, manufacturer of the Foster superheater, has moved its Chicago office from the Peoples Gas building to the Harris Trust building.

J. A. L. Waddell and John Lyle Harrington have announced the dissolution of the firm of Waddell & Harrington, Kansas City, Mo.

William F. Bauer, assistant manager of the railway department of the Edison Storage Battery Company, Orange, N. J., has been appointed manager of the Chicago office, succeeding Charles B. Frayer.

The Union Switch and Signal Company has made the following changes and appointments: central district, Chicago office: V. K. Spicer, special representative; W. H. Talbert, resident manager; George Marloff, office manager; S. E. Gillespie and J. L. Lucks, engineers: eastern district, New York office: A. Dean, resident manager; H. McCready, office manager; H. W. Griffin, R. P. Tuttle, J. W. White and H. H. Hamilton, engineers, and T. H. Patenall, resident manager, Montreal, Que.

George W. Lyndon, formerly secretary and treasurer of the Association of Chilled Car Wheel Manufacturers, was elected its president at the New York meeting of the association held recently.

H. C. Hequembourg has resigned as general purchasing agent of the American Locomotive Company, and the purchasing and storekeeping departments have been placed under the jurisdiction of Leigh Best, vice-president. Mr. Hequembourg is now vice-president of the Standard Chemical Company, Pittsburgh, Pa.

Colonel H. G. Prout has been elected president of the Hall Switch & Signal Company, and William P. Hall is now vice-president and chairman of the executive committee. W. J. Gillingham has been appointed general sales manager, with headquarters at New York City. W. A. Peddle has been appointed acting chief engineer, and W. H. Lane, chief engineer, has been granted leave of absence on account of ill health. Colonel Prout in July last resigned as president of the Union Switch & Signal Company.

C. E. Harrison has resigned as co-receiver of the Barney & Smith Car Co., and H. M. Estabrook will continue as sole receiver.

J. A. Smythe has been appointed boiler expert of the Lukens Iron & Steel Co., and the Jacobs-Shupert U. S. Firebox Co., with headquarters at Coatesville, Pa. Mr. Smythe was formerly with the Parkesburg Iron Co., Parkesburg, Pa.

A. L. Moler has been elected vice-president of the Durbin Train Pipe Connector Co., Ltd., Montreal, Que.

Ralph H. Wilson, southeastern representative of the Walter A. Zelnicker Company, St. Louis, has been appointed advertising manager. E. F. Prichard, formerly auditor of the St. Louis Car Company, St. Louis, Mo., succeeds Mr. Wilson as southeastern representative.

OBITUARY.

Alexander Harvey, secretary of the Detrick & Harvey Machine Company, died at Baltimore on November 22.

Charles A. Moore, president of Manning, Maxwell & Moore, New York, died of heart disease on board the steamer Rotterdam recently.

Morris G. Condon, of H. B. Underwood & Co., Philadelphia, died on December 3.

Eli F. Hart, chairman of the board of the Rodger Ballast Car Company, died at his home in Chicago on November 23.

Charles Dyer, vice-president of the National Dump Car Company, died November 8, 1914, at his home in Denver, Colo., at the age of 70 years.

David P. Sanders, for years manager of the factory of Harlan & Hollingsworth Corporation at Wilmington, Del., died on November 9 at the age of 77 years.